



BOSTON WASTEWATER FACILITIES PLAN

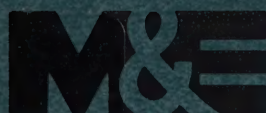
APPENDIX E CALF PASTURE PUMPING STATION EVALUATION

FINAL DRAFT February 1985

EPA Contract Number C-250733-01

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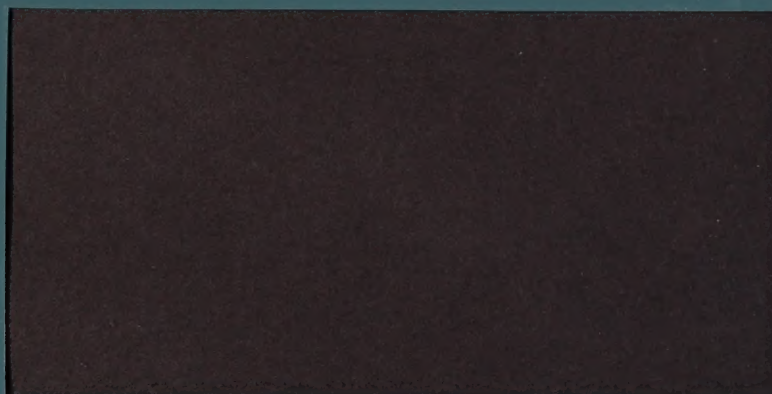
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Appendix

E

TABLE OF CONTENTS

	<u>Page</u>
List of Tables and Attachments	iii
List of Figures	iv
Acknowledgements	vi
EXECUTIVE SUMMARY	S-1
INTRODUCTION	E-1
Purpose	E-2
DESCRIPTION OF FACILITIES	E-3
Screen House	E-3
Pumping Station	E-3
Galleries	E-4
Pumping Units	E-4
Related Equipment	E-5
Pipe Chamber	E-6
DESCRIPTION OF FUNCTION	E-7
Tributary System	E-7
Operating Procedures	E-8
Cause and Frequency of Operation	E-9
ASSESSMENT OF FACILITIES	E-13
Hydraulic Evaluation	E-13
Pump Tests	E-13
Gaging Program	E-15
Summary of Findings	E-19
Physical Evaluation	E-20
Screen House	E-20
Pumping Station	E-21
Pipe Chamber	E-24
Summary of Findings	E-24
ASSESSMENT OF FUNCTION	E-25
Street Flooding and Backups	E-25
Overflows	E-27
Wet Weather	E-27
Dry Weather	E-31
Summary of Conclusions	E-32

TABLE OF CONTENTS

Page		
144	List of Tables and Attachments	
14	List of Figures	
vi	Acknowledgments	
2-1	EXECUTIVE SUMMARY	
2-1	INTRODUCTION	
2-2	PURPOSE	
2-3	DESCRIPTION OF FACILITIES	
2-3	Process House	
2-3	Sampling Station	
2-4	Ballistics	
2-4	Receiving Unit	
2-5	Related Equipment	
2-6	Pipe Channel	
2-7	DESCRIPTION OF FUNCTION	
2-7	Primary System	
2-8	Operating Procedures	
2-9	Causes and Frequency of Operation	
2-11	ASSESSMENT OF FACILITIES	
2-11	Hydraulic Evaluation	
2-11	Pump Tests	
2-12	Casting Program	
2-12	Summary of Findings	
2-12	Physical Evaluation	
2-12	Process House	
2-12	Sampling Station	
2-12	Pipe Channel	
2-12	Summary of Findings	
2-12	ASSESSMENT OF FUNCTION	
2-12	Structural Flooding and Damage	
2-12	Overflow	
2-12	Net Washer	
2-12	Dry Washer	
2-12	Summary of Conclusions	

TABLE OF CONTENTS (Continued)

	<u>Page</u>
ALTERNATIVES	E-35
Evaluation of Alternatives	E-37
Environmental Impacts	E-45
Comparison of Alternatives	E-47
RECOMMENDATIONS	E-51
Summary of July-December 1983 Drying Program Results	E-18
Comparison of Capacity Estimates	E-19
List of Major Equipment at the Calf Pasture Pumping Station	E-21
Calf Pasture Wet Weather Pumping History	E-22
Calf Pasture Dry Weather Pumping History	E-23
Comparison of Alternatives	E-48
Attachment	
Projected Pump Performance Curves	E-37

TABLE OF CONTENTS (Continued)

PAGE

2-32

ALTERNATIVES

2-33

Evaluation of Alternatives

2-34

Environmental Impacts

2-43

Comparison of Alternatives

2-44

RECOMMENDATIONS

LIST OF TABLES AND ATTACHMENTS

<u>Table</u>		<u>Page</u>
E-1	Comparison of Calf Pasture Pumping and Columbus Park Throttling	E-11
E-2	Summary of August 25, 1983 Pump Field Test Program Results	E-14
E-3	Calf Pasture Flow Gaging Program Results - 7/83 through 11/83	E-16
E-4	Summary of July-December 1983 Gaging Program Results	E-18
E-5	Comparison of Capacity Estimates	E-19
E-6	List of Major Equipment at the Calf Pasture Pumping Station	E-22
E-7	Calf Pasture Wet Weather Pumping History	E-28
E-8	Calf Pasture Dry Weather Pumping History	E-31
E-9	Comparison of Alternatives	E-48
<u>Attachment</u>		
E-1	Projected Pump Performance Curves	E-53
E-2	WCC Facilities in the Calf Pasture Pumping Station Trunking System	E-5
E-3	Detail of Junction Chamber at Macomber Circle	E-5
E-4	Location of the New WCC Interceptors	E-5
E-5	Schematic of the WCC Columbus Park Wastewater	E-10
E-6	Correlation Between Rainfall, Throttling, and Pumping at Calf Pasture in 1979	E-10
E-7	Correlation Between Rainfall, Throttling, and Pumping at Calf Pasture in 1980	E-10
E-8	Correlation Between Rainfall, Throttling, and Pumping at Calf Pasture in 1981	E-10

LIST OF TABLES AND ATTACHMENTS

Table	Page
E-1	Comparison of Calf Pasture Pumping and Columbus Park Throttling
E-2	Summary of August 22, 1961 Pump Field Test Program Results
E-3	Calf Pasture Flow Rating Program Results - 1/82 through 11/82
E-4	Summary of July-December 1961 Rating Program Results
E-5	Comparison of Capacity Estimates
E-6	List of Major Equipment at the Calf Pasture Pumping Station
E-7	Calf Pasture Wet Weather Pumping History
E-8	Calf Pasture Dry Weather Pumping History
E-9	Comparison of Altimeters
E-10	Proposed Pump Performance Curves

LIST OF FIGURES

<u>Figure</u>		<u>Page Following</u>
E-1	Location of the Calf Pasture Pumping Station and Major Related Facilities	E-2
E-2	Schematic of the Boston Main Drainage Basin Outlet Works	E-2
E-3	Major Facilities at the Calf Pasture Pumping Station	E-4
E-4	Layout of Screen House	E-4
E-5	Section through the Calf Pasture Pumping Station	E-4
E-6	Plan of Sewage Galleries at the Calf Pasture Pumping Station	E-4
E-7	Plan of Pump Locations at the Calf Pasture Pumping Station	E-4
E-8	Plan of Ground Floor at the Calf Pasture Pumping Station	E-6
E-9	Plan of Pipe Chamber at the Calf Pasture Pumping Station	E-6
E-10	Major Elements of System Tributary to the Calf Pasture Pumping Station	E-8
E-11	MDC Facilities in the Calf Pasture Pumping Station Tributary System	E-8
E-12	Detail of Junction Chamber at Kosciuszko Circle	E-8
E-13	Location of the New BWSC Interceptors	E-8
E-14	Schematic of the MDC Columbus Park Headworks	E-10
E-15	Correlation Between Rainfall, Throttling, and Pumping at Calf Pasture in 1979	E-10
E-16	Correlation Between Rainfall, Throttling, and Pumping at Calf Pasture in 1980	E-10
E-17	Correlation Between Rainfall, Throttling, and Pumping at Calf Pasture in 1981	E-10

LIST OF FIGURES

Page Following

Figure

8-1	Location of the California Pumping Station and Major Related Facilities	8-1
8-2	Schematic of the Western Main Pipeline Basin Outlet Works	8-2
8-3	Major Facilities at the California Pumping Station	8-3
8-4	Layout of Screen House	8-4
8-5	Section through the California Pumping Station	8-5
8-6	Plan of Service Galleries at the California Pumping Station	8-6
8-7	Plan of Pump Location at the California Pumping Station	8-7
8-8	Plan of Ground Floor at the California Pumping Station	8-8
8-9	Plan of Pipe Chamber at the California Pumping Station	8-9
8-10	Major Elements of System Tributary to the California Pumping Station	8-10
8-11	MOC Facilities in the California Pumping Station Tributary System	8-11
8-12	Detail of Junction Chamber at Headwaters Divide	8-12
8-13	Location of the New MOC Interceptors	8-13
8-14	Schematic of the MOC Colchester Park Headworks	8-14
8-15	Correlation Between Mainline, Tributary, and Pumping at California Pumping Station in 1979	8-15
8-16	Correlation Between Mainline, Tributary, and Pumping at California Pumping Station in 1980	8-16
8-17	Correlation Between Mainline, Tributary, and Pumping at California Pumping Station in 1981	8-17

LIST OF FIGURES (Continued)

<u>Figure</u>		<u>Page Following</u>
E-18	Correlation Between Rainfall, Throttling, and Pumping at Calf Pasture in 1982	E-10
E-19	Plan of Flow Gage Locations at the Pipe Chamber	E-16
E-20	Operation of a Typical Combined Sewer Regulator	E-26
E-21	Tributary Area Selected for Flooding Analysis	E-26
E-22	Flow Schematic Indicating Flow Allocations Used in Flooding Analysis	E-26
E-23	Detail of B Street Regulator and Results of Flooding Analysis	E-26
E-24	Critical Combined Sewer Overflows in the Calf Pasture Tributary System	E-28
E-25	Frequency Distribution for Columbus Park Flows, 1979-1982	E-32

List of Figures (Continued)

Page	Figure
E-10	Correlation Between Rainfall, Throughfall, and Pumping at East Tapsite in 1981
E-11	Plan of Flow Meter Location at the Pipe Chamber
E-12	Operation of a Typical Combined Sewer Regulator
E-13	Velocity Area Selected for Flooding Analysis
E-14	Flow Schematic Indicating Flow Allocations Used in Flooding Analysis
E-15	Detail of a Typical Regulator and Results of Flooding Analysis
E-16	Typical Combined Sewer Wastewater in the East Branch Tributary System
E-17	Frequency Distribution for Columbus Park Flow, 1975-1981

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EXECUTIVE SUMMARY

The Calf Pasture Pumping Station is located on Columbia Point adjacent to the J.F.K. Library at the University of Massachusetts, Boston Campus. It was constructed in 1883 and put into service in 1884. From 1884 until 1968 the station operated continuously 24 hours a day to discharge dry and wet weather flow from the Boston Main Drainage Basin to Moon Island for discharge to Boston Harbor. In 1968 the Metropolitan District Commission (MDC) put into operation new wastewater facilities which diverted flow previously tributary to the Calf Pasture Pumping Station to the Deer Island Wastewater Treatment Plant, and the continuous operation of Calf Pasture Pumping Station was discontinued. However, the pumping station was maintained to help alleviate flooding in the area tributary to it and to provide back-up to the operations of the MDC Deer Island wastewater treatment facilities.

The station only operates when flow is being restricted at the MDC Columbus Park headworks. Flow is restricted at the headworks when the available pumping capacity of the MDC Deer Island Main Pumping Station is exceeded. During the period from 1970 to 1983 Calf Pasture operated on an average of 35 days a year. Excluding 1981, 1982, and 1983 as extraordinary, it operated on an average of 17 days a year. It pumped on dry weather days in six of the 14 years of record analyzed, ranging from a low of three days in 1976 to a high of 40 days in 1981. For the same period, it pumped wet weather flow on an average of 31 days a year, pumping an average of 207 million gallons a year. Excluding 1981, 1982, and 1983 as extraordinary, wet weather pumping averaged 16 days a year and 92 million gallons a year.

Purpose and Scope

The purpose of this report was to assess if and when the Calf Pasture Pumping Station can be phased out of operation and what, if anything, should be done to the station to allow it to function until it can be phased out of operation.

The analysis covered the screen house, pumping station and discharge chamber. It assessed the relevance of the functions currently performed by the station and its physical condition. Alternatives for improving the station were developed and analyzed, and recommendations were provided.

Findings

Assessment of Function. It was found that the pumping station does not contribute significantly to the alleviation of flooding in the tributary area. The back-up function that it provides to the MDC was considered relevant when it is used to

transport dry weather flow for discharge off Moon Island that would otherwise have been discharged into the Inner Harbor. A statistical analysis of flows through the MDC Columbus Park headworks indicates that Calf Pasture could pump the difference between those flows and the peak dry weather flow in 99 percent of the cases examined. It was therefore concluded that the station has adequate capacity to perform the dry weather transport function it is currently called upon to perform. Dry weather back-up to MDC's Deer Island facilities should not be required after the pumping facilities at Deer Island are improved. The work associated with these improvements is scheduled by court order to be completed by April of 1988. The relevance of the back-up function as it applies to wet weather flows is uncertain. There is reason to believe that the contribution of the Calf Pasture Pumping Station in this regard is not significant. However, this issue must be further studied.

Assessment of Condition. The level of maintenance in the station dropped off significantly when continuous operations were discontinued in 1968. As a result, the station is currently in poor physical condition. The pumps in the station are in poor condition. They have an estimated remaining service life of five years. They can only pump approximately one-third of their design capacity. The station is unprotected by screens that would prevent debris from damaging equipment. There is no means of measuring the flow that is discharged from the station. There are several safety hazards in the station such as poor lighting, floor decking, ventilation, and railings.

Alternatives

It was assumed that the Calf Pasture Pumping Station will continue to be operated through April, 1988. Several alternatives for improving the station for operation were considered. The alternatives were evaluated based on engineering, environmental and cost considerations. Capital, operating and maintenance, and abandonment costs were developed for each alternative, and the present value of the total costs determined.

Alternative No. 1 - No Action. Continue to operate the station as it currently is. Present value of total costs, \$1,755,000.

Alternative No. 2 - Safety Improvements. Improve floor decking, lighting, railings, and ventilation; install a new influent gate, equipment guards, and combustible gas detectors; and clean out debris and equipment not in use. Capital cost, \$475,000. Present value of total costs, \$2,339,000.

Alternative No. 3 - Safety, Flow Measuring and Piping Improvements. Make all Alternative No. 2 improvements, add flow measuring capability, and attempt to increase pumping capacity by

replacing suction piping on two pumps. Capital cost, \$656,000. Present value of total costs, \$2,520,000.

Alternative No. 4 - Safety, Flow Measuring and Serviceability Improvements. Make all Alternative No. 3 improvements, add flow screening capability, add heating and ventilating in occupied areas, and additional piping improvements intended to improve pumping capacity. Capital cost, \$1,292,000. Present value of total costs, \$3,164,000.

Alternative No. 5 - Safety, Flow Measuring, Serviceability and Pumping Improvements. Make all Alternative No. 4 improvements and add two new pumps. Capital cost, \$1,698,000. Present value of total costs, \$3,570,000.

Recommendations

Based on the conclusion of the analysis that the station should continue to operate for a period of time, safety improvements are recommended. Improvements beyond safety improvements are not recommended because the station has adequate capacity to handle dry weather flows and because it is assumed that the station will not be required to operate beyond 1988. The specific recommendations are as follows:

- . Make safety improvements as described in Alternative No. 2 immediately, at an estimated cost of \$475,000 (ENR 4100).
- . Undertake further study to evaluate the environmental significance of the wet weather operation of the station.
- . Continue to operate the station to pump dry weather flow until reliable pumping capacity is provided at the MDC Deer Island Wastewater Treatment Plant.
- . Continue to operate the station to pump wet weather flow until further study shows that wet weather pumping is not environmentally significant or until combined sewer overflow regulating facilities become operational in the area affected by the station.
- . Abandon the station when its dry and wet weather operations are discontinued, at an estimated cost of \$180,000 (ENR 4100).
- . Pursue transfer of ownership and operating responsibility of the station to the MDC.

INTRODUCTION

The Calf Pasture Pumping Station is located on Columbia Point adjacent to the J.F.K. Library and the University of Massachusetts, Boston campus. The location of the station relative to the major elements of the Boston Water and Sewer Commission's (BWSC) and the Metropolitan District Commission's (MDC) wastewater collection systems is shown on Figure E-1.

The station was constructed in 1883 as part of the outlet works that conveyed sanitary and combined wastewater collected in the Boston Main Drainage Basin to Moon Island for detention and disposal on outgoing tides. The basic elements of the outlet works are depicted on Figure E-2. As shown on Figure E-2, outlet works include: the screen house, the pumping station, the deposit sewers, the Dorchester Bay tunnel and the Moon Island detention and disposal facilities. These facilities continued as the outlet works for the Boston Main Drainage Basin until 1968 when MDC's Deer Island Wastewater Treatment Plant was put into operation. At that time, wastewater from the Boston Main Drainage Basin was diverted to Deer Island for treatment and disposal.

The construction of the Deer Island treatment plant and its associated transport facilities including the Columbus Park headwaters was intended to eliminate the need for the original outlet works.(1) According to a report to the MDC that recommended the construction of the headworks and tunnel system, the sanitary flows expected to reach the headworks would increase during the design period from 1950 to 1985, while the stormwater flow would decrease at the same time.(2) This decrease in stormwater flow entering the system was predicted as the result of the enforcement of Section 13, Chapter 720 of the Massachusetts Acts of 1941, which gave the MDC power to levy fines against member cities and towns for failure to comply with MDC regulations regarding the discharge of surface drainage into the MDC sewerage system. It was envisioned that Calf Pasture would be required to operate only during periods of high flow in the initial years following 1967-68. The pumping station was to be abandoned once the stormwater flow reaching the headworks was reduced to a level that could be accommodated by the downstream tunnel and treatment facilities. This is currently not the case and the station continues to operate to provide relief to the MDC system. While the relief function is called upon principally

1. Charles A. Maguire and Associates, Engineering Report to the MDC on a Proposed Plan of Sewerage and Sewage Disposal for the Boston Metropolitan Area. Metropolitan District Commission, February 1951.
2. Ibid.

under wet weather conditions, the outlet works have been utilized to provide relief during dry weather when mechanical problems at Deer Island have occurred.

Discharges from the pump station are transported to Moon Island without treatment, as the detention facilities at Moon Island have been by-passed for some time. Recently chlorination facilities have been provided at the pumping station for the purpose of chlorinating dry weather discharges.

Purpose

The focus of this analysis is on the Calf Pasture Pumping Station. However, the screen house and pipe chamber were also considered because they are closely related to the operation of the pumping station. Other aspects of the outlet works, such as the deposit sewers, the Dorchester Bay tunnel, and the facilities at Moon Island, are not considered.

The purpose of this report is to assess if and when the Calf Pasture Pumping Station can be phased out of operation and what, if anything, should be done to the station to allow it to function until it can be phased out of operation.

The analysis includes a description of the pumping station and an evaluation of its condition and the function it performs. The condition of the station is evaluated to determine its physical limitations. The function performed by the station is evaluated to assess the role the station plays in the wastewater collection system and the current and future significance of that role. Alternative actions with respect to the station are developed and evaluated, and recommendations are provided.

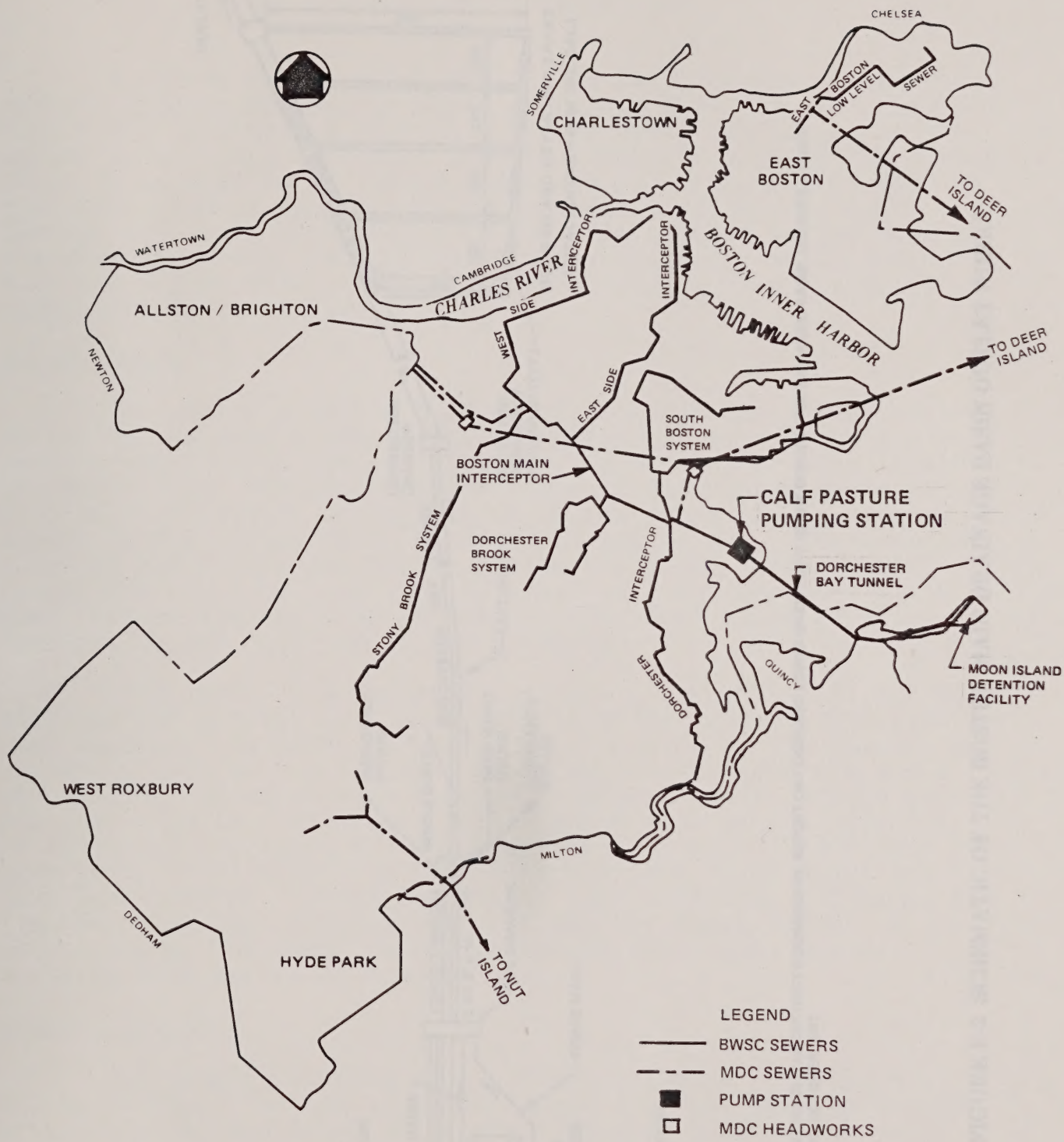
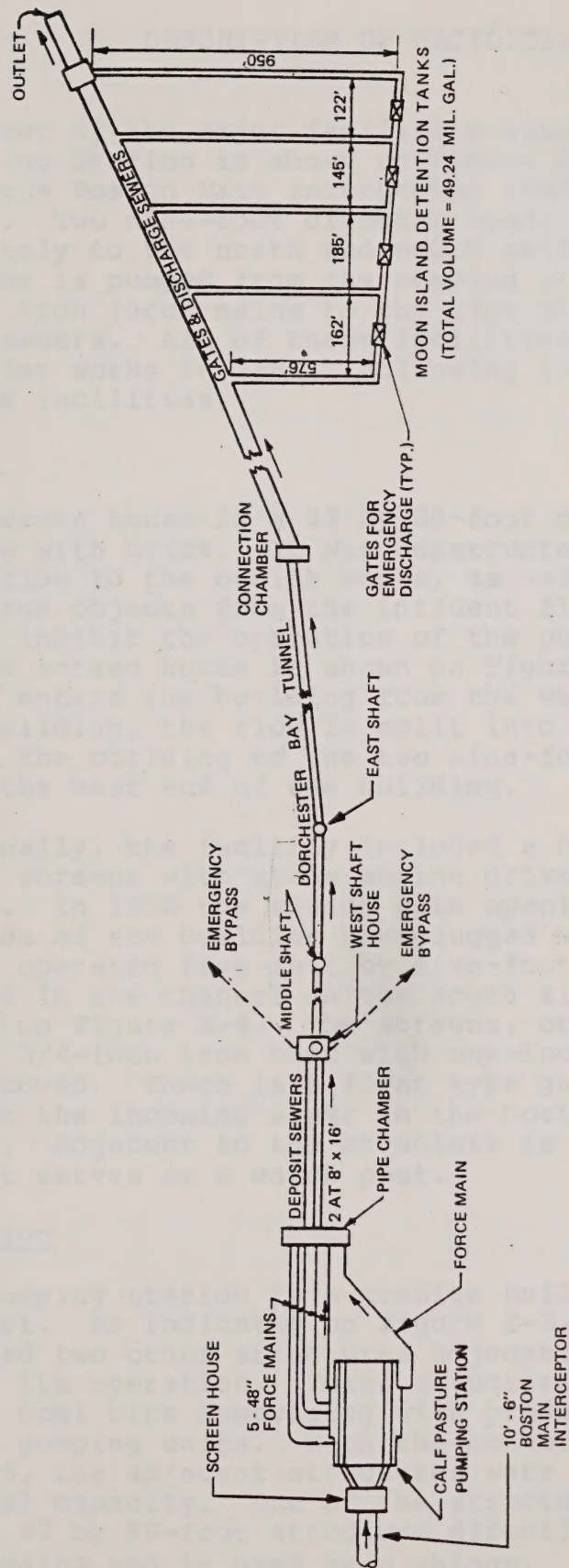


FIGURE E-1 LOCATION OF THE CALF PASTURE PUMPING STATION AND MAJOR RELATED FACILITIES



SOURCE: METROPOLITAN DISTRICT COMMISSION, REPORT ON COMBINED SEWER OVERFLOWS IN THE DORCHESTER BAY AREA; CAMP, DRESSER & McKEE, INC., OCTOBER 1981.

FIGURE E-2 SCHEMATIC OF THE BOSTON MAIN DRAINAGE BASIN OUTLET WORKS

DESCRIPTION OF FACILITIES

A layout of the major facilities associated with the Calf Pasture Pumping Station is shown on Figure E-3. As indicated on Figure E-3, the Boston Main Interceptor (BMI) discharges to the screen house. Two nine-foot diameter conduits connect the screen house separately to the north and south galleries of the pumping station. Flow is pumped from the pumping station through four 48-inch cast iron force mains to the pipe chamber at the head of the deposit sewers. All of these facilities were constructed with the outlet works in 1883. Following is a description of each of these facilities.

Screen House

The screen house is a 37 by 30-foot granite building lined on the inside with brick. It was constructed to house gates to control the flow to the outlet works, as well as screens intended to remove large objects from the influent flow which could damage or otherwise inhibit the operation of the pumps in the station. A layout of the screen house is shown on Figure E-4. The ten-foot six-inch BMI enters the building from the west. Immediately inside the building, the flow is split into two channels which pass through the building to the two nine-foot diameter brick conduits at the east end of the building.

Originally, the facility included a hydraulically driven gate and two screens with steam engine driven hoists in series in each channel. In 1958 the sluice gate opening in the channel on the north side of the building was plugged with concrete and a new cylinder operated five-foot by five-foot timber sluice gate was installed in the channel on the south side of the building, as indicated on Figure E-4. The screens, originally the cage type made of 3/4-inch iron bars with one-inch clear openings, have been removed. There is a float type gage that indicates the flow depth in the incoming sewer in the northwest corner of the screen house. Adjacent to the structure is a small wooden building that serves as a watch post.

Pumping Station

The pumping station is a granite building approximately 210 by 80-feet. As indicated on Figure E-3, the pumping station originally had two other structures adjacent to it which were important to its operation. These structures housed the boiler, chimney, and coal bins associated with producing steam for the steam driven pumping units. With the conversion to electric power in 1935, the adjacent structures were no longer required in their original capacity. One of the structures was demolished. The other, a 62 by 90-foot structure directly adjacent to the building, remains and is used as a garage.

Power is supplied to the pumping station from the nearby switch house located as indicated on Figure E-3. The building belongs to the City of Boston, but the majority of the equipment in the building belongs to Boston Edison. The switch house supplies 13.8 kilovolt (kv) service to BWSC transformers located just outside of the station. Each unit is a 1200 kilovolt-ampere (kva) oil-filled outdoor transformer which steps the power down to 460 volts, three phase for use in the station.

The pumping station houses galleries which receive flow from the screen house, and the pumping units and related equipment necessary to lift the wastewater from the galleries to the pipe chamber. Figure E-5 presents a sectional view of the station. A description of the galleries, pumping units and related equipment follows.

Galleries. Flow enters the pumping station through the south 9-foot diameter conduit. The conduit discharges into the south gallery which is one of two enclosed galleries running longitudinally along the north and south walls of the pumping station. Access to the galleries is provided through manholes located in the top of the galleries. There are five cross galleries connecting the north and south galleries. A plan of the galleries is shown on Figure E-6. At the ends of each cross gallery are cast iron sluice gates provided to allow isolation of the cross galleries. The gates were originally motor operated, but the motors have been removed.

As shown on Figure E-6, a fresh water well was provided between cross galleries number 4 and 5. This well is no longer hydraulically separate from the galleries.

Pumping Units. The pumping units in the Calf Pasture Pumping Station are oriented over the five cross galleries. Originally, each cross gallery had associated pumping units consisting of one steam engine driving two plunger pumps. The pumps in galleries number 1 and 2 were driven by horizontal steam engines, the pumps in galleries number 3, 4, and 5 were driven by vertical steam engines.

Around 1912, the steam driven pumping units for galleries number 1 and 2 were replaced with steam turbine driven pumping units. At the same time, an elevated pump room floor with cast iron floor plates and steel beams was constructed at elevation 1.80 (Boston City Base) over cross galleries number 1 and 2. This floor is indicated on Figure E-7. Also at the same time, the pump suction nozzles were enclosed in cage type cast iron gratings to protect the pumps from large objects.

Around 1935, the pumping equipment in these two galleries was replaced with four Worthington Model 30-MS horizontal end suction centrifugal pumps. Three of these pumps are currently in

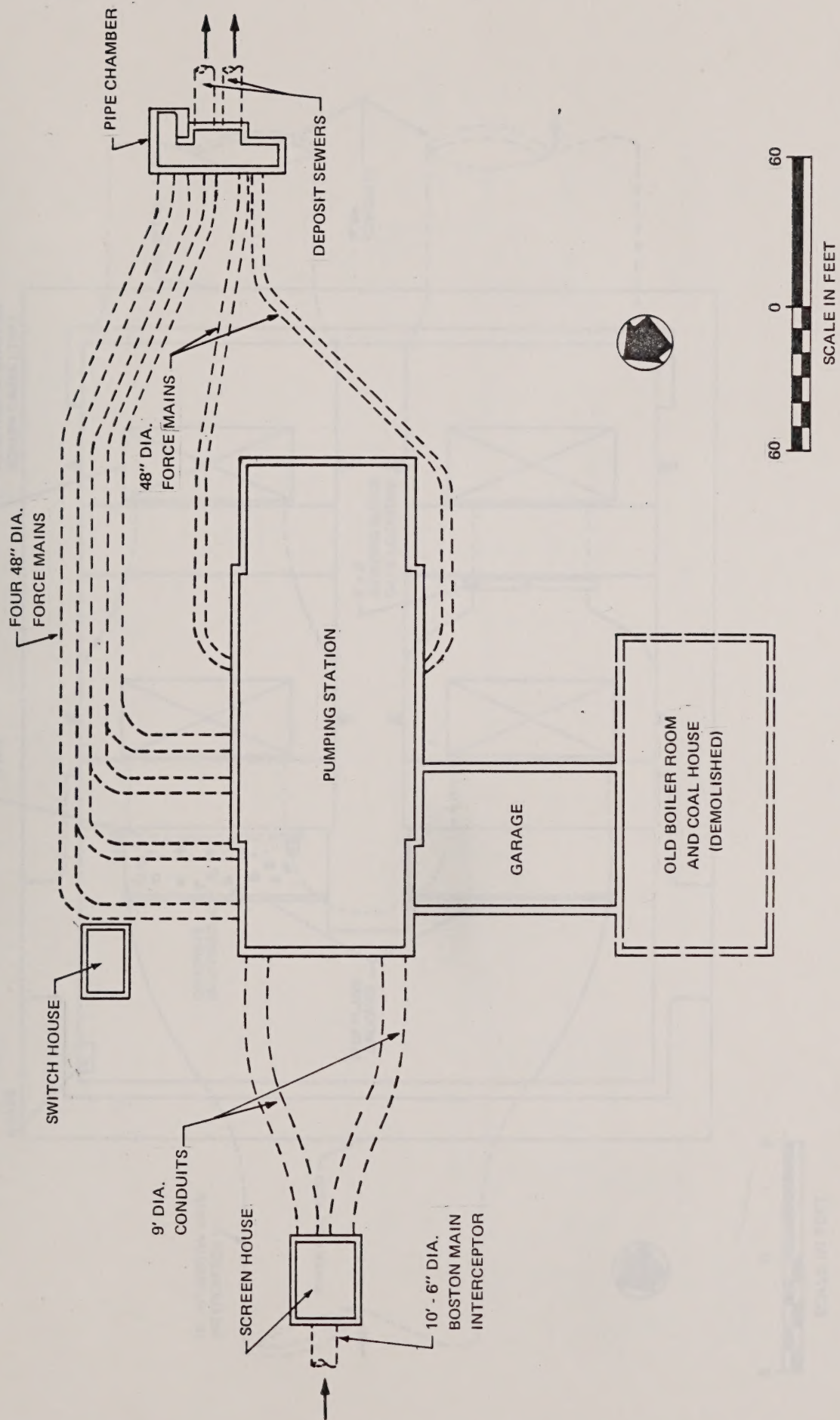


FIGURE E-3 MAJOR FACILITIES AT THE CALF PASTURE PUMPING STATION

Power is supplied to the building by a 1000-volt
transformer which is located on the roof of the building.
The transformer is connected to the power lines by a
cable which runs through the roof of the building.
The cable is supported by a series of brackets which
are attached to the roof of the building. The brackets
are made of steel and are painted with a rust-
proof paint. The cable is made of copper and is
enclosed in a lead sheath to protect it from
the weather.

The building is divided into two main sections.
The first section is the main office area which
contains the desks and chairs. The second section
is the storage area which contains the filing
cabinets and the bookshelves. The building is
well lit and is very comfortable to work in.
The temperature is kept at a constant level and
the air is filtered to keep it clean and fresh.

The building is located on a corner lot and
has a very good view of the city. The building
is surrounded by a low wall and a sidewalk.
The sidewalk is made of concrete and is very
wide. The wall is made of brick and is painted
white. The building is very modern and is
very attractive. It is a very good example
of modern office building design.

The building is very well maintained and is
in excellent condition. It is a very good
example of modern office building design.

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in excellent condition. It is a very good
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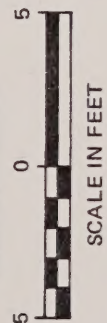
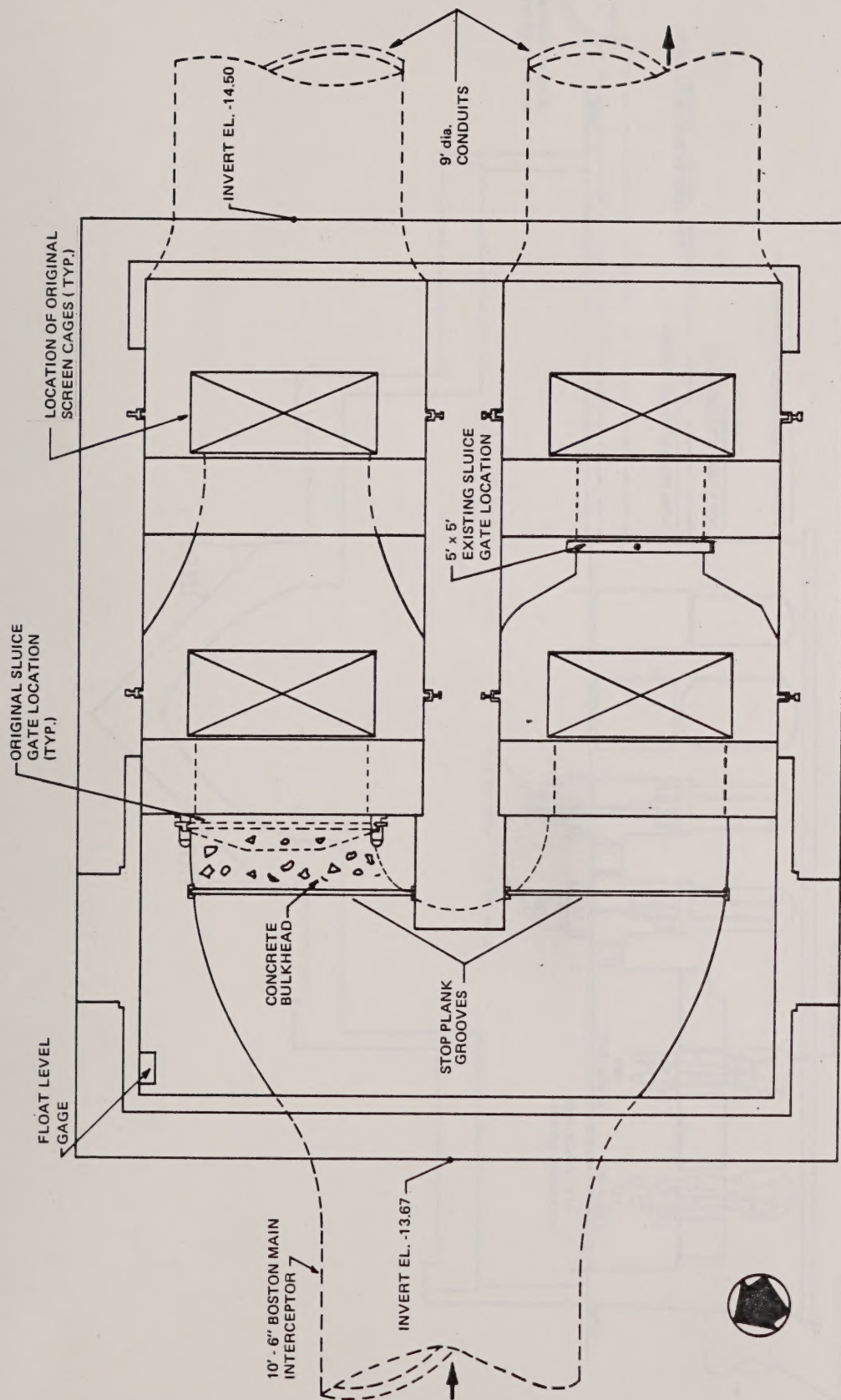


FIGURE E-4 LAYOUT OF SCREEN HOUSE

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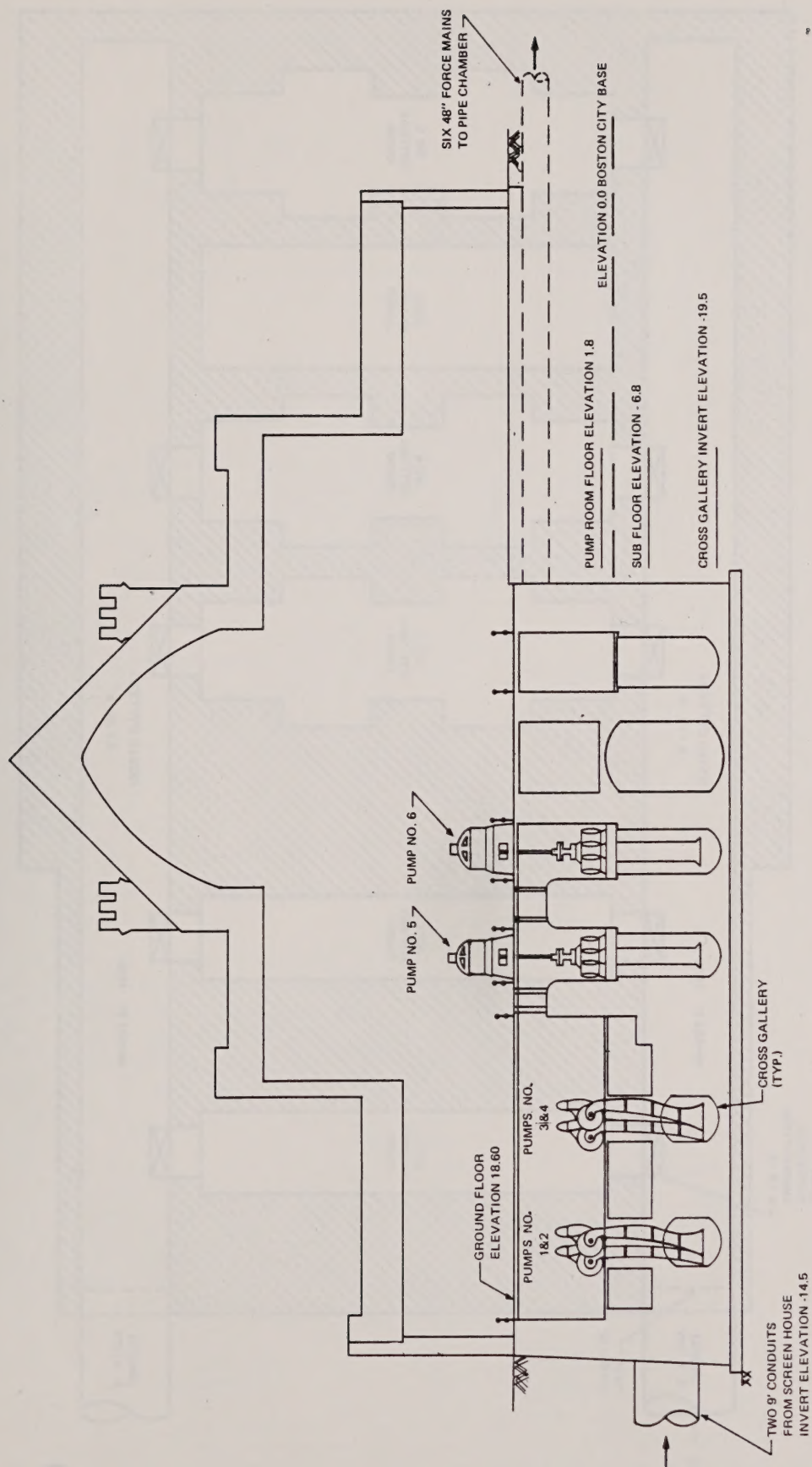


FIGURE E-5 SECTION THROUGH THE CALF PASTURE PUMPING STATION

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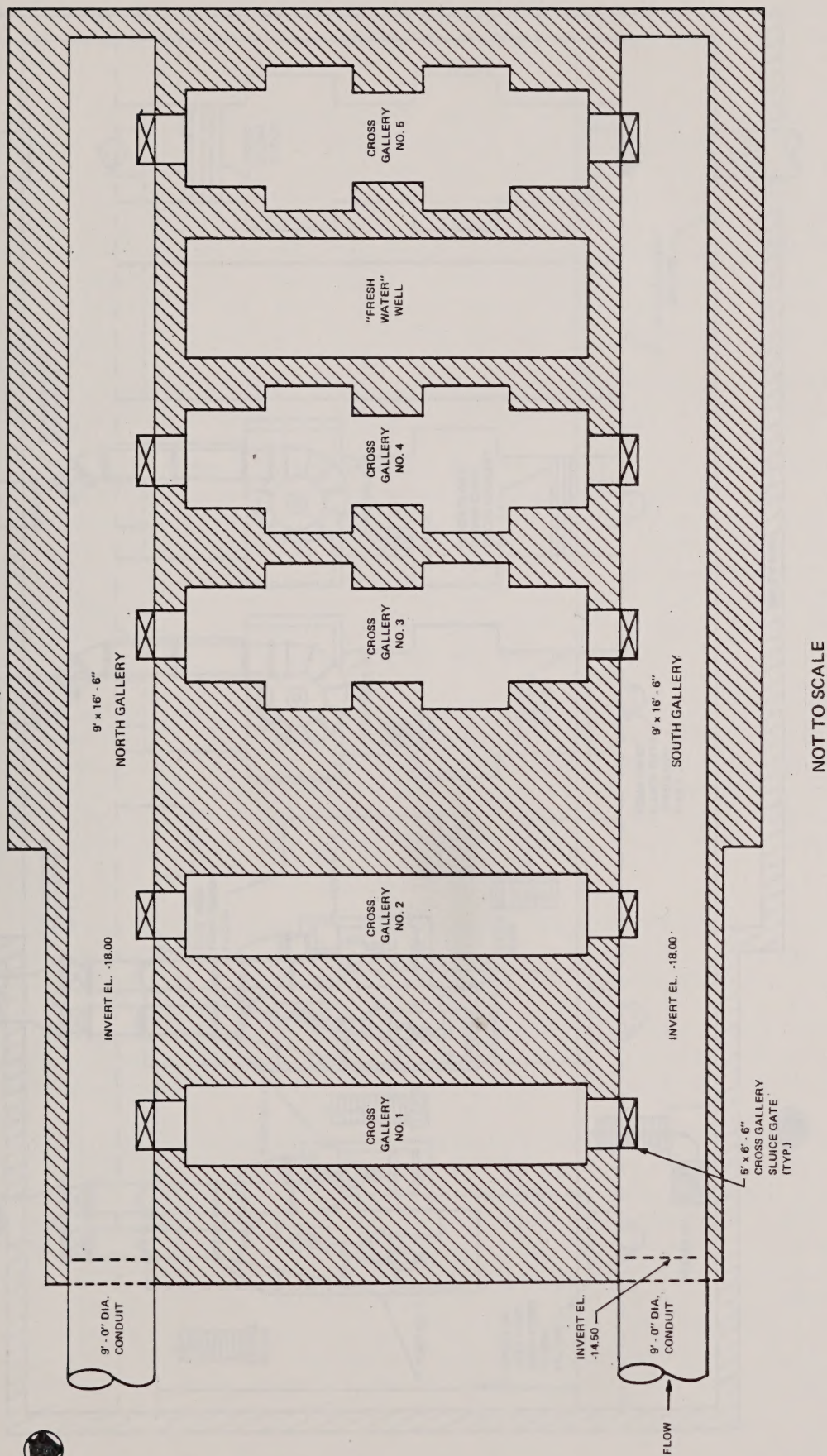
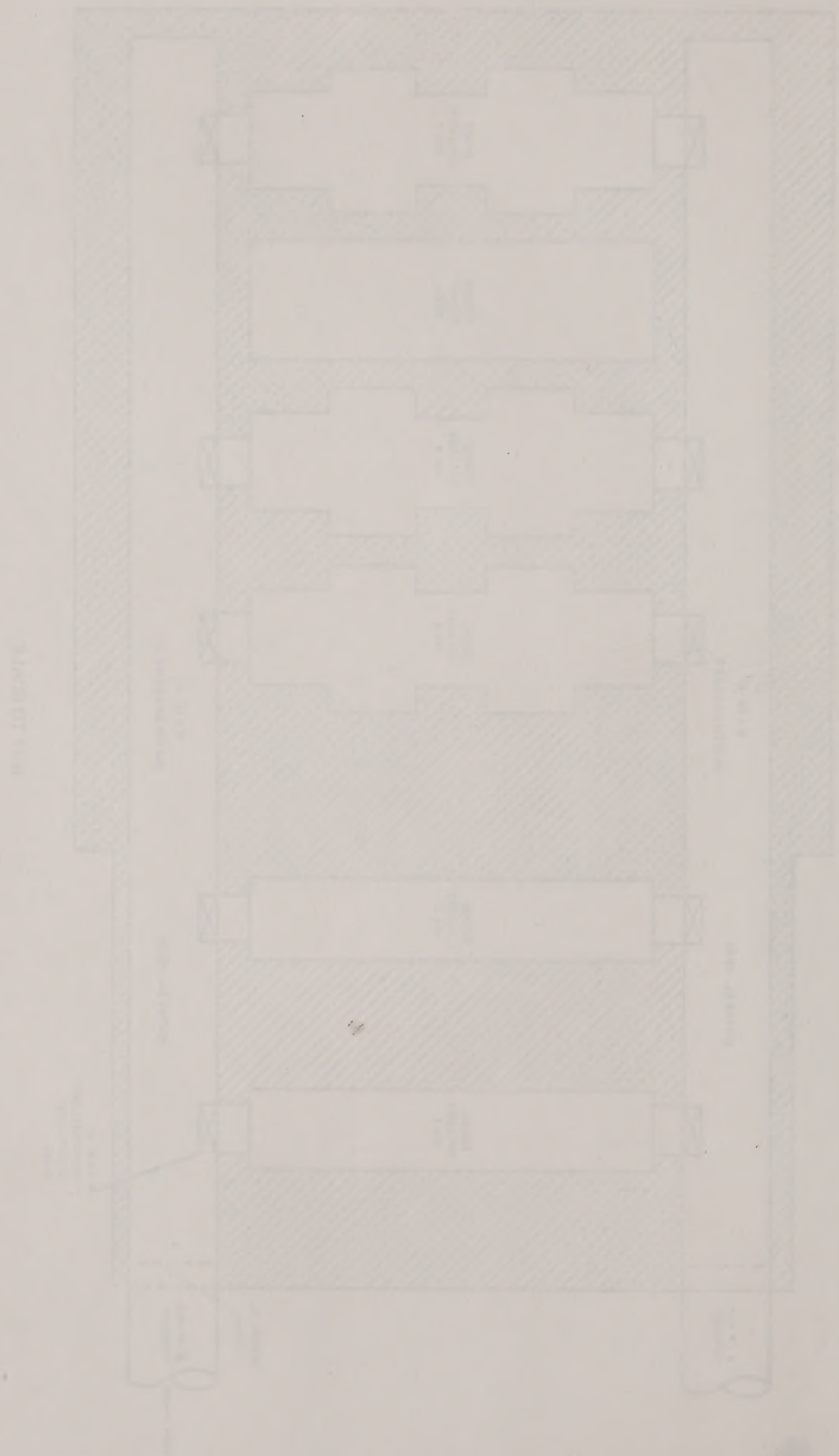
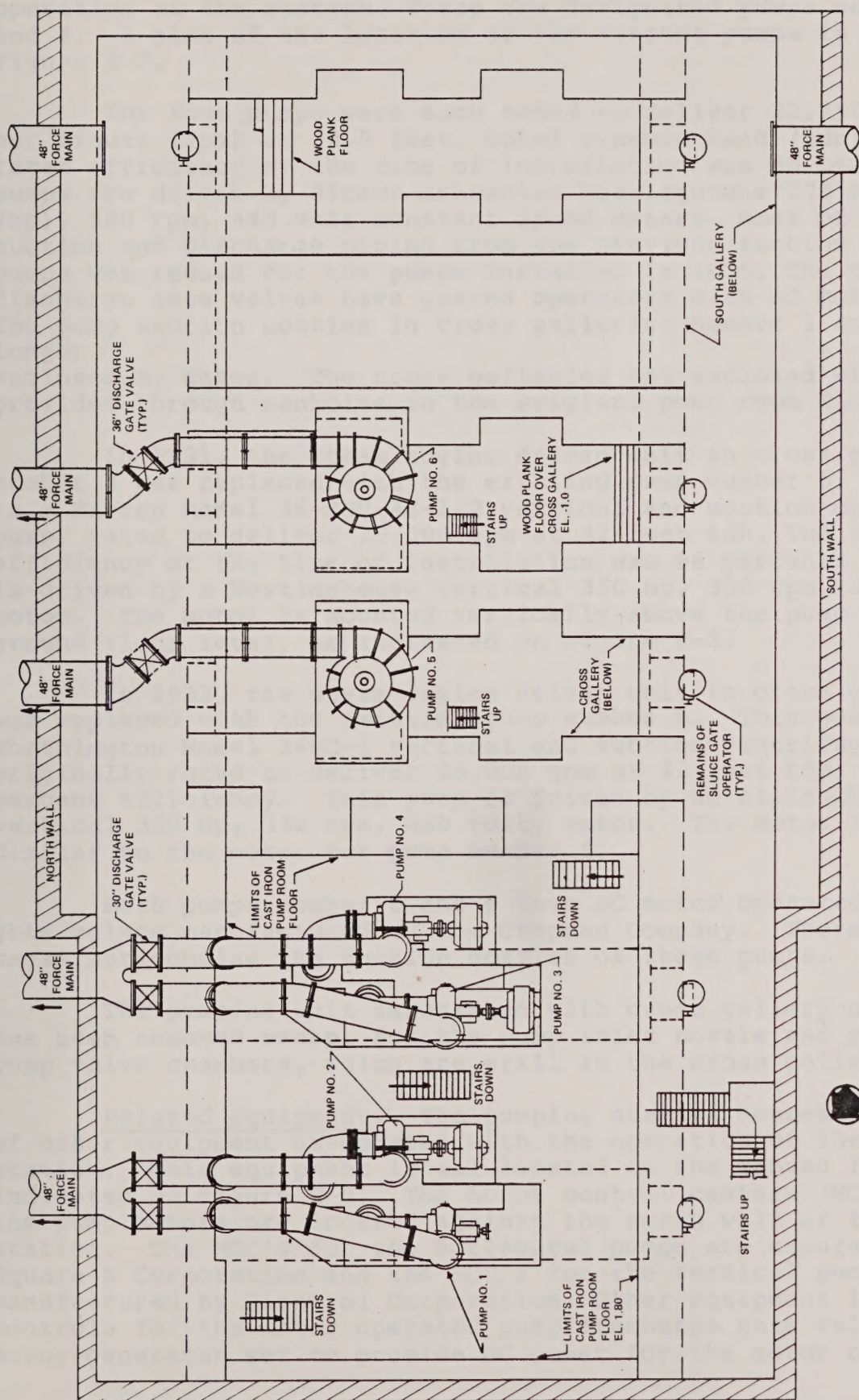


FIGURE E-6 PLAN OF SEWAGE GALLERIES AT THE CALF PASTURE PUMPING STATION

FIGURE 1. PLAN OF THE TOMB OF THE PRINCE OF WEI, CHANG-CHANG, CHINA





NOT TO SCALE

FIGURE E-7 PLAN OF PUMP LOCATIONS AT CALF PASTURE PUMPING STATION

operation at the station. These are designated pumps number 2, 3 and 4. A plan of the location of the current pumps is shown on Figure E-7.

The four pumps were each rated to deliver 22,750 gallons per minute (gpm) at 38.5 feet. total dynamic head (tdh). The rated efficiency at the time of installation was 85 percent. The pumps are driven by direct connected Westinghouse 275 horsepower (hp), 580 rpm, 440 volt constant speed motors. Most of the suction and discharge piping from the previous turbine driven pumps was reused for the pumps installed in 1935. The current discharge gate valves have geared operators with AC motor drives. The pump suction nozzles in cross galleries number 1 and 2 are no longer enclosed by cages. The cross galleries are enclosed with access provided through manholes in the original pump room floor.

In 1931, the steam engine driven unit in cross gallery number 3 was replaced with the existing pump number 5. This pump is a Warren Model 36-SSV-43-1/2 vertical end suction centrifugal pump, rated to deliver 29,000 gpm at 42 feet tdh. The rated efficiency at the time of installation was 86 percent. This pump is driven by a Westinghouse vertical 350 hp, 350 rpm, 440 volt, motor. The motor is mounted vertically above the pump on the ground floor level, as indicated on Figure E-8.

In 1933, the steam engine driven unit in cross gallery 4 was replaced with the existing pump number 6. This pump is a Worthington Model 36MC-1 vertical end suction centrifugal pump, originally rated to deliver 26,000 gpm at 42 feet tdh, and 86 percent efficiency. This pump is driven by an Allis-Chalmers vertical 350 hp, 350 rpm, 440 volt, motor. The motor location is similar to the motor for pump number 5.

Both pumps number 5 and 6 have DC motor operated discharge gate valves manufactured by the Chapman Company. There are no cages surrounding the suction nozzles of these pumps.

The pumping unit associated with cross gallery number 5 has been removed except for the pump inlet nozzle and plunger pump valve chambers, which are still in the cross gallery.

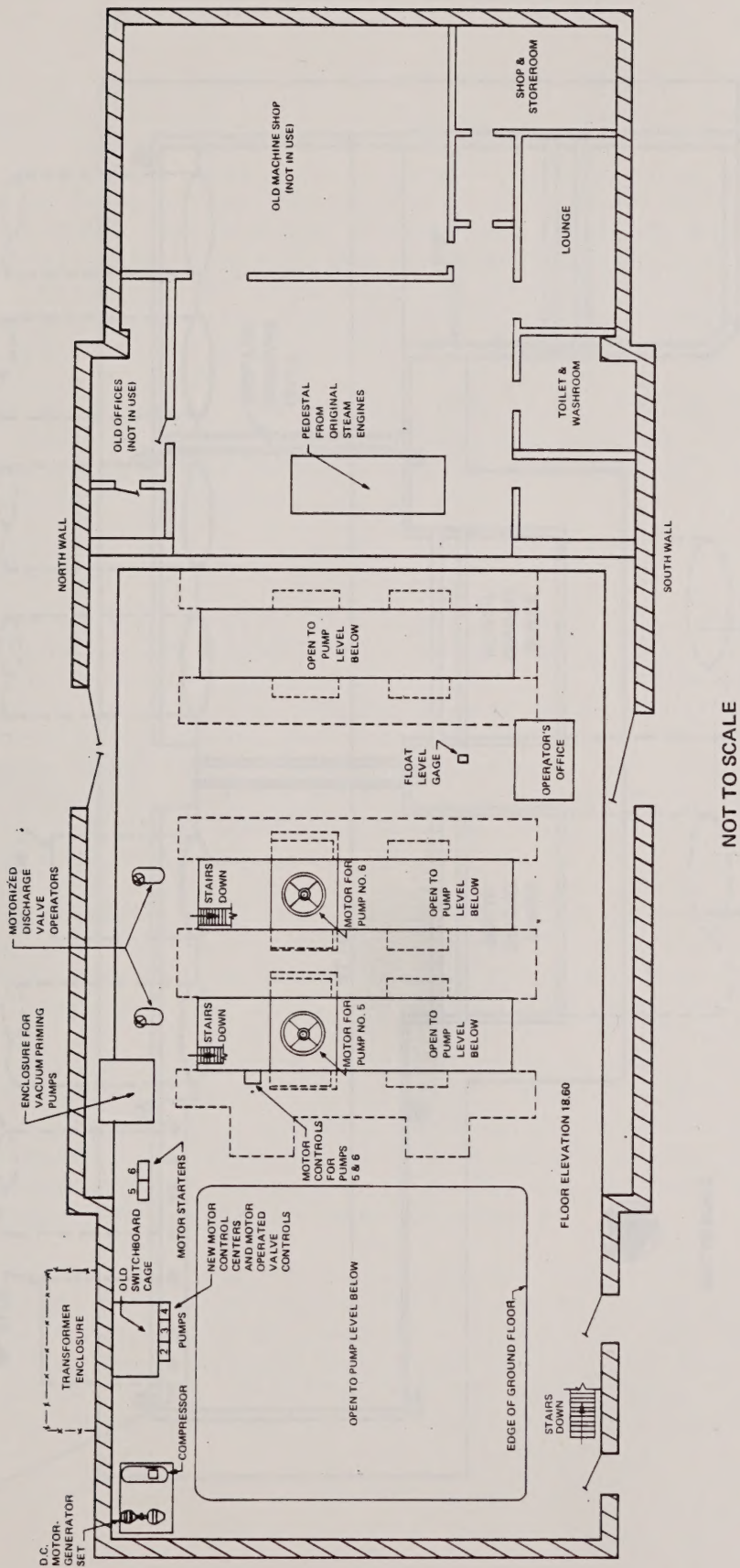
Related Equipment. The pumping station houses a variety of other equipment associated with the operation of the station. This equipment is all located on the ground floor as indicated on Figure E-8. The motor control centers (MCC's) for the pump motors are located against the north wall of the pumping station. The MCC's for the horizontal pumps are manufactured by Square D Corporation and the MCC's for the vertical pumps are manufactured by Firetrol Corporation. Other equipment includes controls for the motor operated pump discharge gate valves, and a motor-generator set to provide DC power for the motor operated

gate valves for pumps number 5 and 6. There is a motor driven air compressor and tank unit for general plant air and a vacuum priming system for the wastewater pumps. The vacuum priming system until recently consisted of two Nash Hytor vacuum pumps and appurtenant piping. The older, larger vacuum pump is driven by a Westinghouse 870 rpm, 7-1/2 hp motor. The newer, smaller vacuum pump is driven by a Lincoln 1745 rpm, three hp motor. These units are in the process of being replaced with two Kinney Vacuum Company five hp vacuum pumps. An overhead bridge crane with manual ten-ton hoist was installed in 1933 to service pumps number 5 and 6. There is no bridge crane or hoist to service pumps number 1 through 4.

The remainder of the ground floor level is occupied by an operators office, a storeroom, a toilet and washroom, and miscellaneous equipment that no longer function. There is a float-type level gage outside of the operators office which indicates the liquid depth in the cross galleries.

Pipe Chamber

The pipe chamber is a 51-foot by 10-foot 6-inch granite below ground chamber located east of the pumping station as shown on Figure E-3. The chamber receives flow from the pumping station and directs it to the deposit sewers which lead to the Dorchester Bay tunnel and to Moon Island. Six force mains connect the pipe chamber with the pumping station. Four of the force mains are connected to the existing pumps in the station, while two are plugged and are no longer in service. Each active force main has a wooden flap gate at the point where the force main enters the pipe chamber. Figure E-9 shows the configuration of the pipe chamber and the location of the force mains.



NOT TO SCALE

FIGURE E-8 PLAN OF GROUND FLOOR AT THE CALF PASTURE PUMPING STATION

E-6a

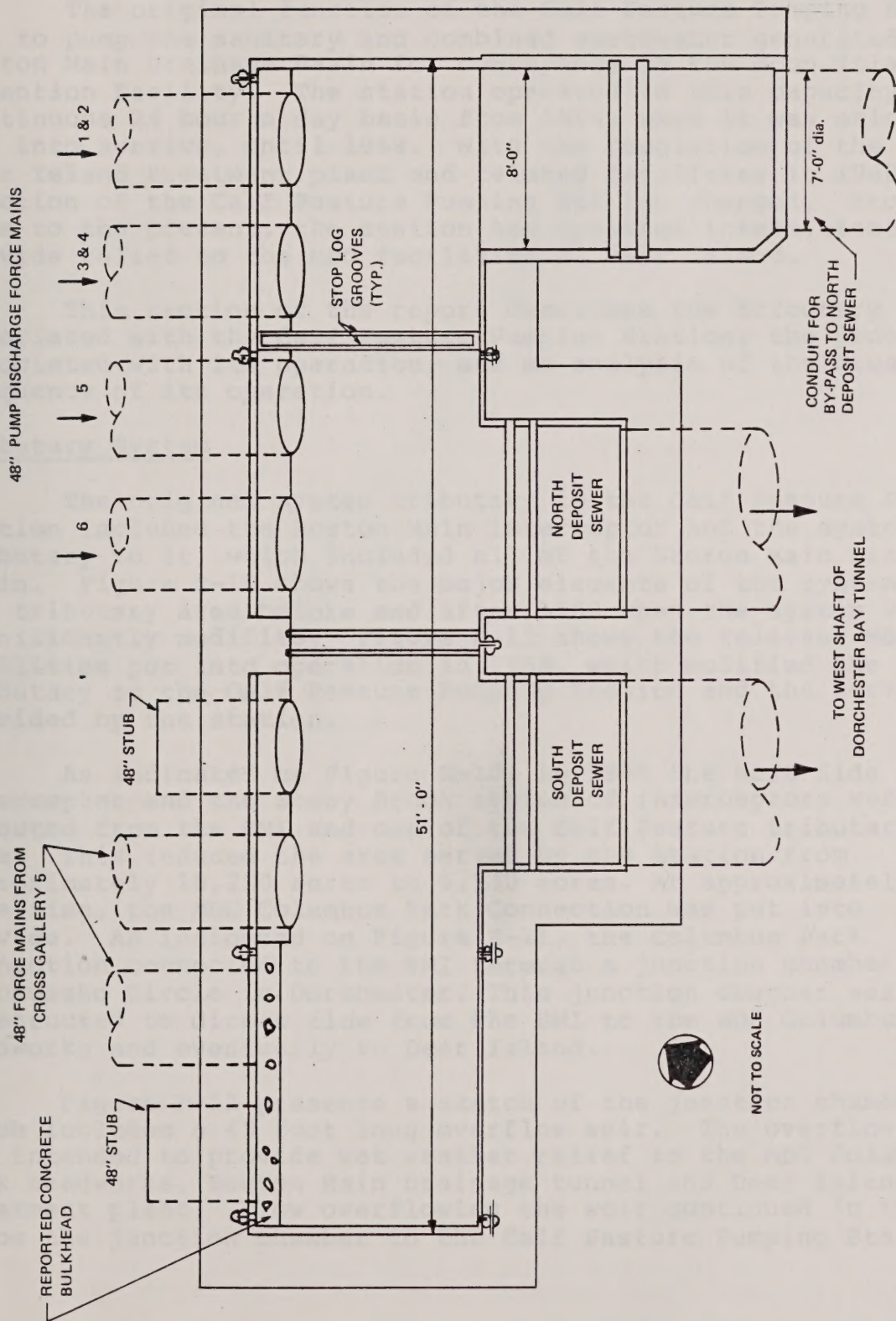


FIGURE E-9 PLAN OF PIPE CHAMBER AT THE CALF PASTURE PUMPING STATION

E-66

DESCRIPTION OF FUNCTION

The original function of the Calf Pasture Pumping Station was to pump the sanitary and combined wastewater generated in the Boston Main Drainage Basin for conveyance to the Moon Island Detention Facility. The station operated in this capacity on a continuous 24 hour a day basis from 1884, when it was originally put into service, until 1968. With the completion of the MDC Deer Island treatment plant and related facilities in 1968, the function of the Calf Pasture Pumping Station changed. From that time to the present, the station has operated intermittently to provide relief to the MDC facilities at Deer Island.

This section of the report describes the tributary system associated with the Calf Pasture Pumping Station; the procedures associated with its operation; and an analysis of the cause and frequency of its operation.

Tributary System

The original system tributary to the Calf Pasture Pumping Station included the Boston Main Interceptor and the systems tributary to it, which included all of the Boston Main Drainage Basin. Figure E-10 shows the major elements of the system and its tributary area before and after 1968 when the system was significantly modified. Figure E-11 shows the relevant MDC facilities put into operation in 1968, which modified the area tributary to the Calf Pasture Pumping Station and the service provided by the station.

As indicated on Figure E-10, in 1968 the West Side Interceptor and the Stony Brook system of interceptors were rerouted from the BMI and out of the Calf Pasture tributary area. This reduced the area served by the station from approximately 10,220 acres to 6,740 acres. At approximately the same time, the MDC Columbus Park Connection was put into service. As indicated on Figure E-11, the Columbus Park Connection connected to the BMI through a junction chamber near Kosciuszko Circle in Dorchester. This junction chamber was constructed to direct flow from the BMI to the MDC Columbus Park headworks and eventually to Deer Island.

Figure E-12 presents a sketch of the junction chamber which includes a 45 foot long overflow weir. The overflow weir was intended to provide wet weather relief to the MDC Columbus Park headworks, Boston Main Drainage tunnel and Deer Island treatment plant. Flow overflowing the weir continued in the BMI below the junction chamber to the Calf Pasture Pumping Station.

The section of the BMI downstream of the junction chamber received sanitary sewage and stormwater from the Columbia Point area until 1982 when the BWSC built the Mount Vernon Street Sewer conveying sanitary sewage from the area directly to the MDC Columbus Park Connection. Storm drainage in this area is still tributary to the BMI.

BWSC has several projects underway which will further affect the collection system tributary to the Calf Pasture Pumping Station. Currently under construction is the New Boston Main Interceptor (NBMI), and proposed for construction in the near future are the New East Side Interceptor - North and South Branches and the New Albany Street Interceptor. Figure E-13 shows the locations of these projects. The NBMI will carry the majority of the flow from the tributary area that previously entered the present BMI and convey it directly to the Columbus Park headworks. The New East Side and Albany Street Interceptors will serve the area currently served by the present East Side Interceptor. These projects will alter the configuration and the hydraulics of the system tributary to the Calf Pasture Pumping Station, but will not alter the arrangement by which the station provides relief to the headworks and the Deer Island treatment facilities.

Operating Procedures

During normal dry weather conditions, all flow entering the junction chamber from the BMI is diverted to the MDC Columbus Park Connection. A review of the flow quantification data for the system tributary to the MDC Columbus Park headworks indicates that the average daily flow is approximately 62 million gallons a day (mgd). At this flow the water surface at the junction chamber is approximately 2.5 feet below the overflow weir crest and no flow passes over the weir and into the section of the BMI that leads to the pumping station.

During wet weather conditions, the flow from the areas with combined sewers tributary to the BMI increases. This increased flow is normally diverted to the Columbus Park headworks at the junction chamber. The headworks has a design capacity of approximately 180 mgd; however, due to recurring operational difficulties that limit the pumping capacity at the Deer Island Main Pumping Station, flow through the headworks is not permitted to reach the design value. Once the available pumping capacity at Deer Island is reached, the operators at the Main Pumping Station notify the headworks personnel to restrict flow at the headworks.

Flow can be restricted at three MDC headworks in the system, Ward Street, Columbus Park and Chelsea Creek. When it is necessary to restrict flow, current practice is to first restrict

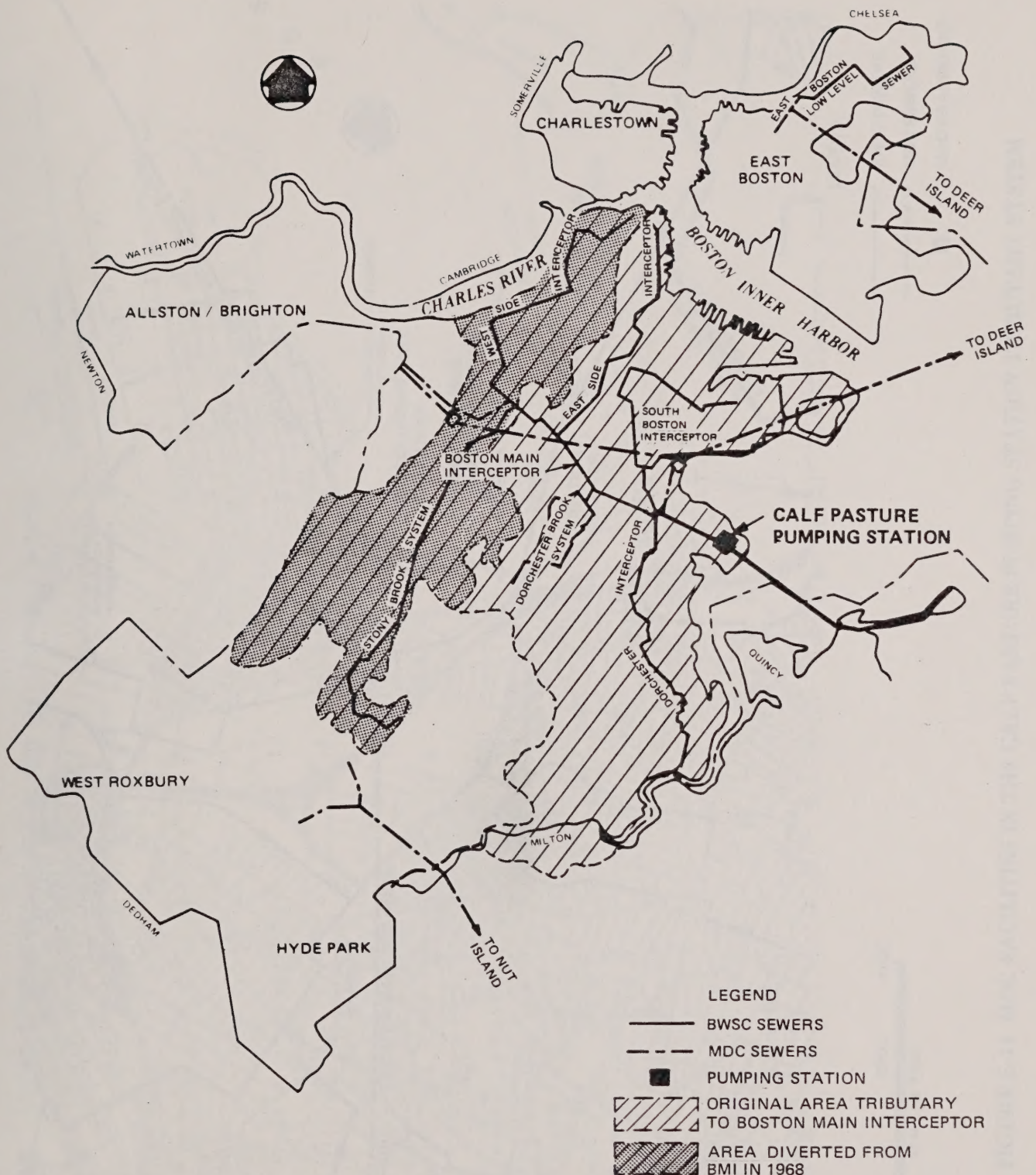
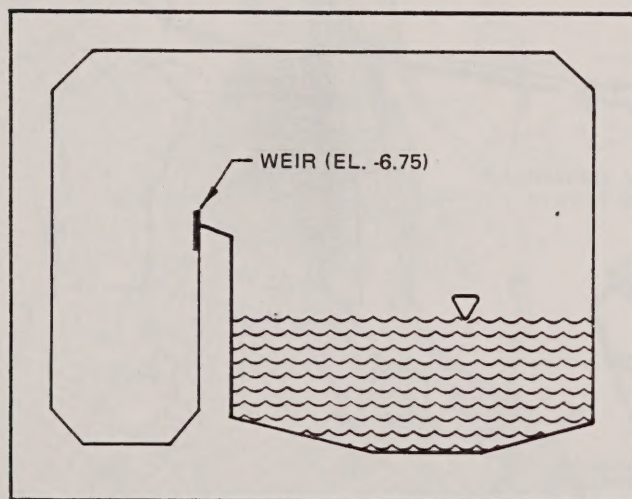
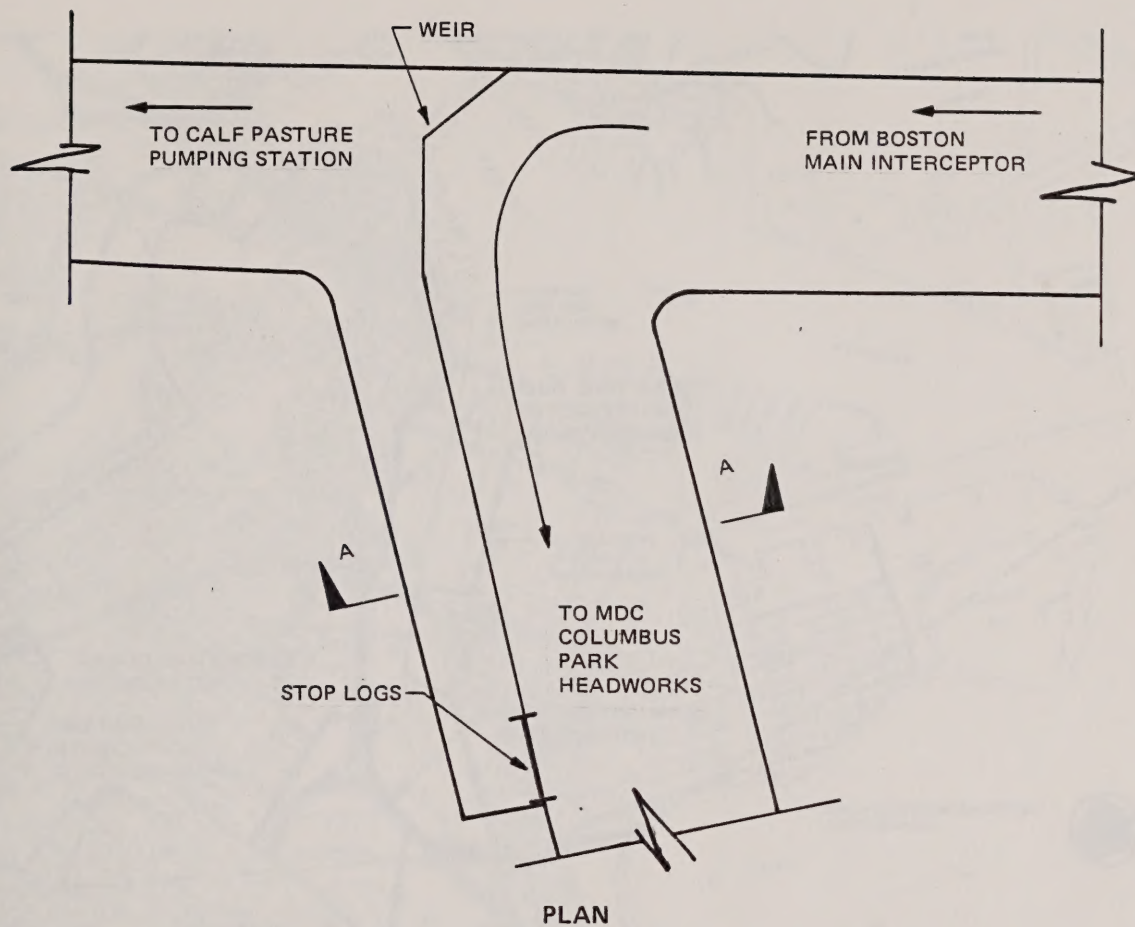


FIGURE E-10 MAJOR ELEMENTS OF SYSTEM TRIBUTARY TO THE CALF PASTURE PUMPING STATION



FIGURE E-11 MDC FACILITIES IN THE CALF PASTURE PUMPING STATION TRIBUTARY SYSTEM



NOT TO SCALE

FIGURE E-12 DETAIL OF JUNCTION CHAMBER AT KOSCIUSZKO CIRCLE

E-8c

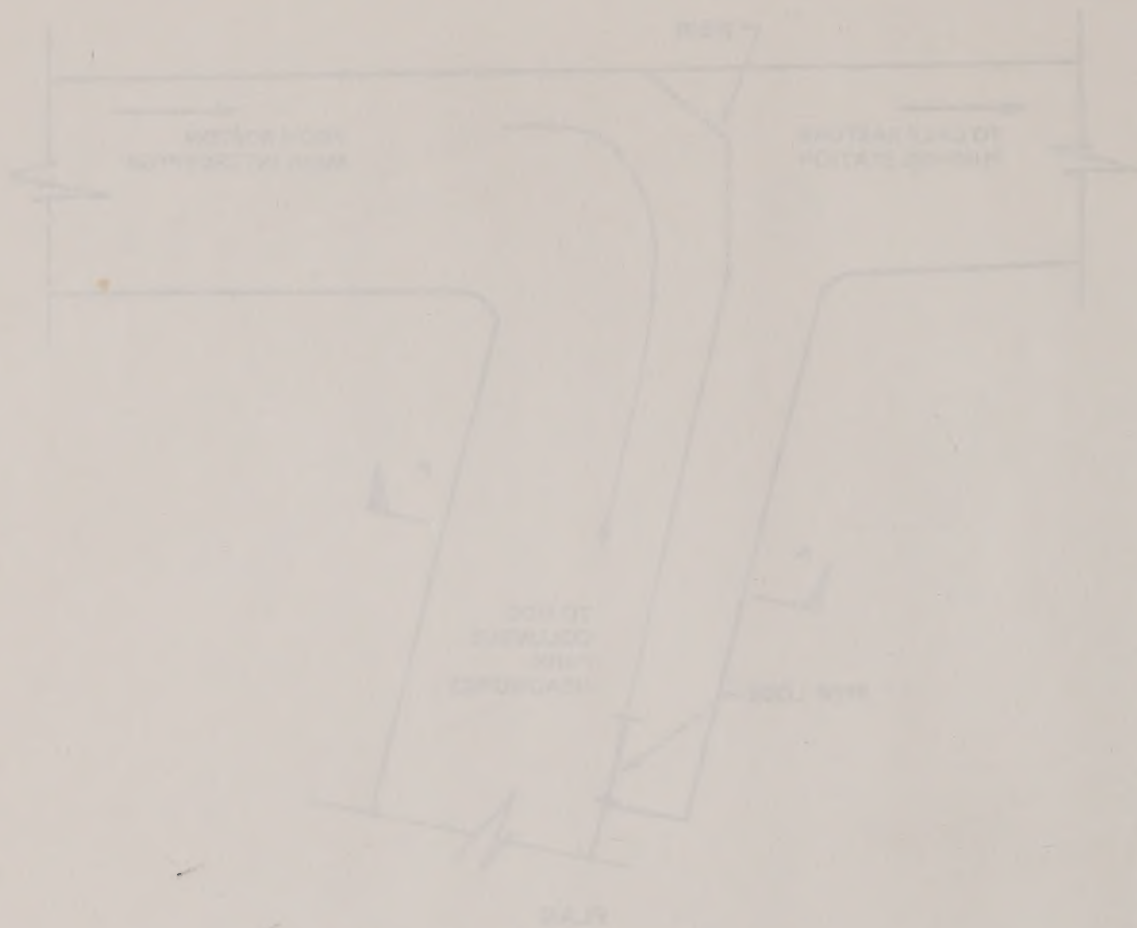


FIGURE 2-12 DETAIL OF SECTION CHANGES AT ROCHAMORE CIRCLE



2000 0 2000 4000
SCALE IN FEET

LEGEND

- BWSC SEWERS
- - - MDC SEWERS
- MDC HEADWORKS

FIGURE E-13 LOCATION OF NEW BWSC INTERCEPTORS

E-8d



STATE OF CALIFORNIA
COUNTY OF SAN DIEGO

BEFORE ME, the undersigned authority, on this day personally appeared _____, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office this _____ day of _____, 19____.

NOTARY PUBLIC FOR THE STATE OF CALIFORNIA

flow at Ward Street. Columbus Park is the second in line for flow restriction.

The Columbus Park headworks consists of four identical channels each consisting of a manually operated sluice gate, a coarse screen, grit chamber, and Parshall flume. A schematic of the configuration of the MDC headworks is shown on Figure E-14.

To reduce the flow through the headworks, the influent sluice gate leading to each channel is closed from a wide open position to one that reduces the incoming flow to an acceptable rate. The flow reduction is referred to as throttling. Once throttling is initiated, the MDC headworks personnel alert BWSC operating personnel at the Calf Pasture Pumping Station by telephone to be prepared to begin pumping. The throttling of flow at the headworks causes a backwater condition to occur in the Columbus Park Connection. If the throttling at the headworks continues for any length of time, the Columbus Park Connection surcharges increasing the depth of flow in the junction chamber. If the throttling continues long enough, the depth of flow in the junction chamber rises above the weir crest, and flow passes over the weir through the BMI to the Calf Pasture Pumping Station.

Upon notification of throttling at the headworks, personnel at the Calf Pasture Pumping Station monitor the liquid level in the Screen House. If this level reaches elevation -2.0 (BCB) which corresponds to a depth of 12 feet in the influent sewer, pumping operations begin.

The use of this depth to begin pumping is based on concerns with safeguarding the station as opposed to operational concerns with the tributary system. At this depth, the liquid level in the station is two feet below the pump room floor in cross galleries number 3 and 4. This allows a two foot "cushion" to start the pumps before the sewage level reaches the floor and potentially damages the pumps.

Normally, when the station is activated, one of the three operable horizontal pumps is started first since they are easier to prime than the vertical pumps. If the liquid level in the station continues to rise, additional pumps are brought into service until the liquid level begins to stabilize. The liquid level in the Screen House is monitored while the station is on line, and pumping continues until the level in the wet well is reduced to approximately the elevation of the weir in the junction chamber, -6.75 (BCB).

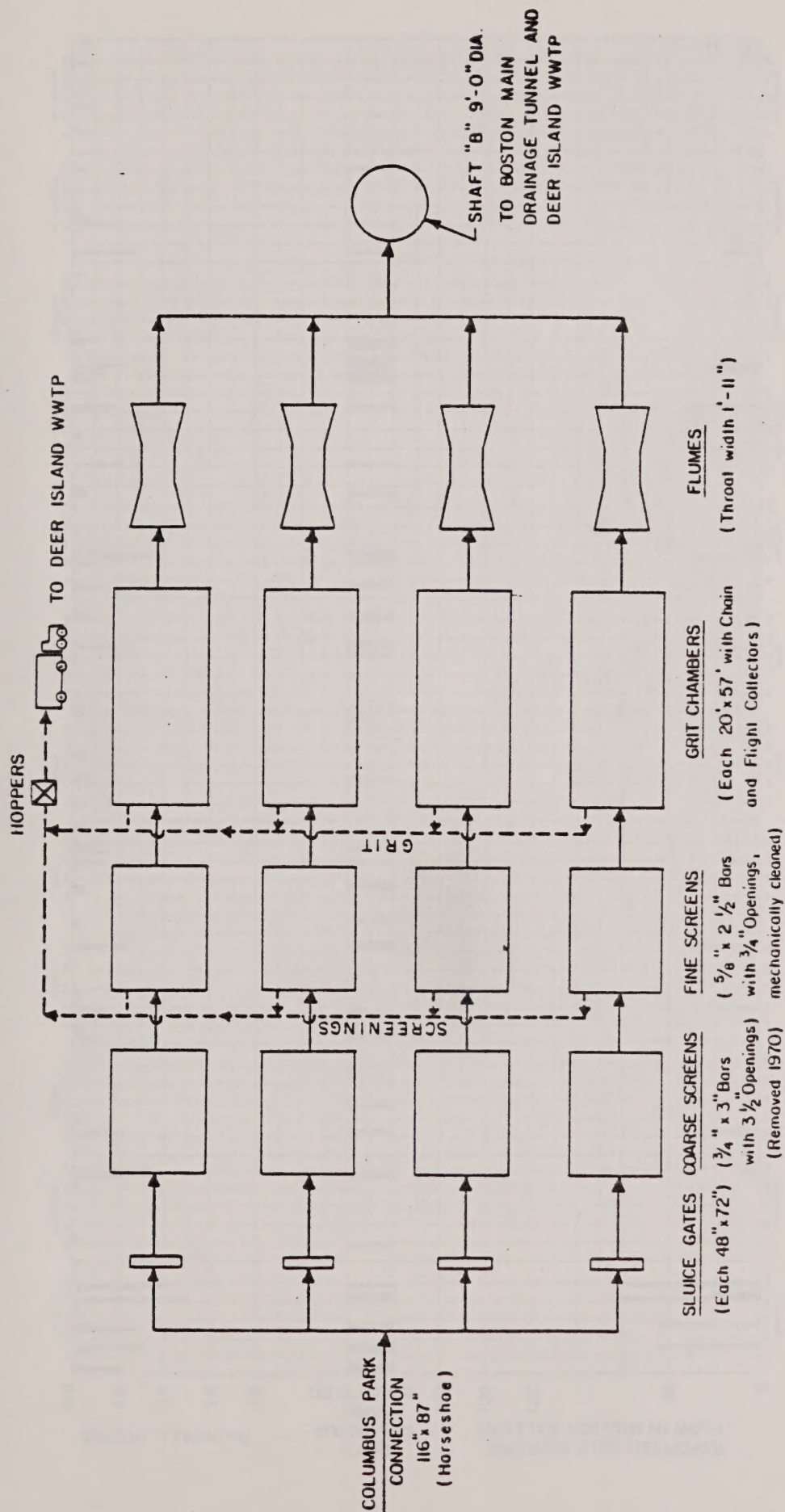
Cause and Frequency of Operation

The cause and frequency of operation of the Calf pasture Pumping Station is a function of both weather conditions and

operational effectiveness at the Deer Island treatment plant. Wet weather conditions can increase the flow in the system through stormwater inflow beyond the available pumping capacity at Deer Island. Operational difficulties such as equipment breakdowns at the Deer Island Main Pumping Station can reduce the pumping capacity to a point where the Calf Pasture station is required to operate even under dry weather conditions. In either case, the need for pumping at Calf Pasture is attributable to a limitation in available pumping capacity at Deer Island. Pumping Station is called upon to provide wet or dry weather relief, operating records were reviewed for 1979 through 1983. Records were reviewed for the pumping station and the Columbus Park headworks along with rainfall data for the same period. Figures E-15 through E-18 present plots which indicate the date and quantity of rainfall, the date of throttling at Columbus Park and the date and reported quantity of pumping at the Calf Pasture for 1979, 1980, 1981 and 1982 respectively. A review of these plots will indicate that (1) all pumping events at Calf Pasture Pumping Station were related to a throttling event at Columbus Park; and, (2) not all throttling events at Columbus Park were rainfall related.

Records were further reviewed to determine the number of pumping days at Calf Pasture as compared with the number of throttling days at Columbus Park for the period 1970 through 1983. The results of this review are summarized in Table E-1.

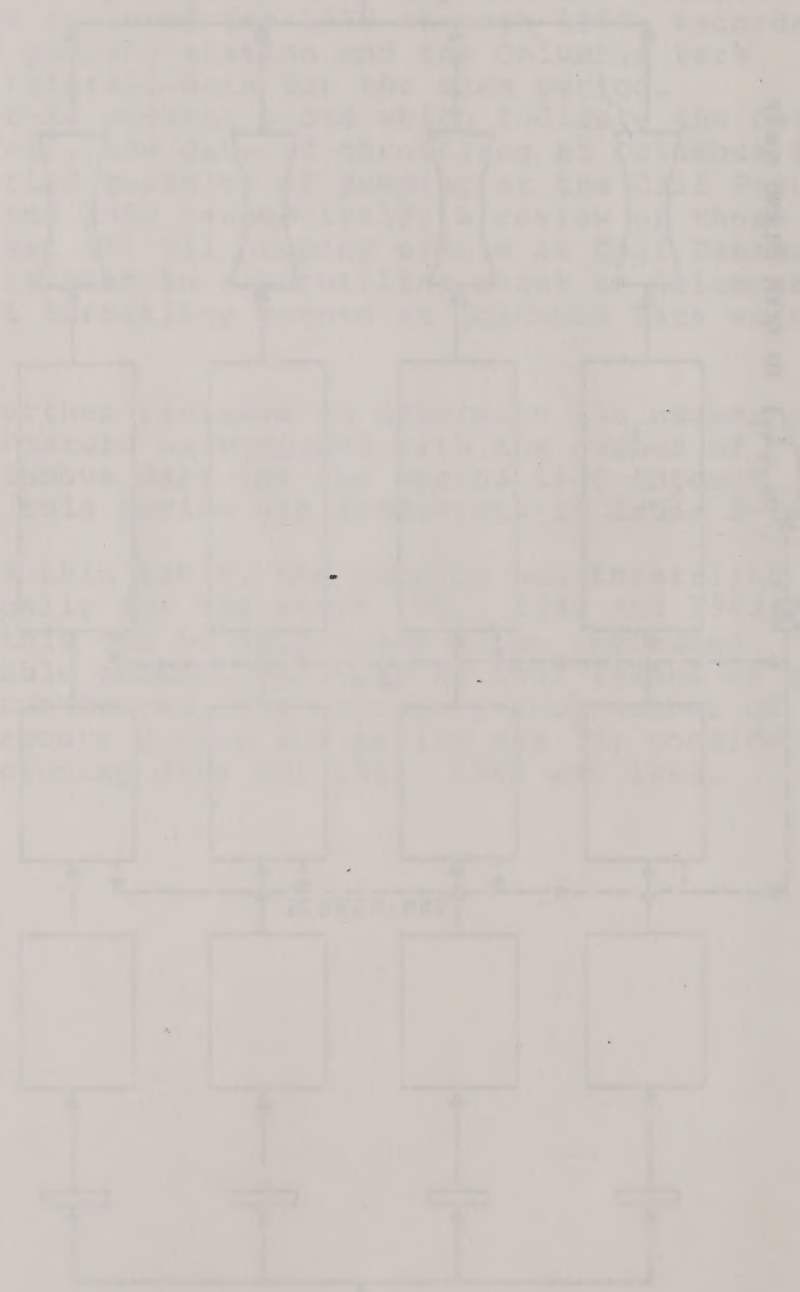
As indicated in this table, the pumping and throttling days increase dramatically for the years 1981, 1982 and 1983. It is not clear whether this can be attributed to an increased deterioration of reliable pumping capacity at Deer Island or a series of special circumstances. The average annual number of days pumped by Calf Pasture during the period was 35, considering all years, and 17, excluding data for 1981, 1982 and 1983.



SOURCE: METROPOLITAN DISTRICT COMMISSION, REPORT ON COMBINED SEWER OVERFLOWS IN THE DORCHESTER BAY AREA; CAMP, DRESSER & MCKEE, INC., OCTOBER 1981.

FIGURE E-14 SCHEMATIC OF THE MDC COLUMBUS PARK HEADWORKS

The following is a description of the system. The system is designed to provide a means of communication between the various components of the system. The system is designed to provide a means of communication between the various components of the system. The system is designed to provide a means of communication between the various components of the system.



Transmitter
 Receiver

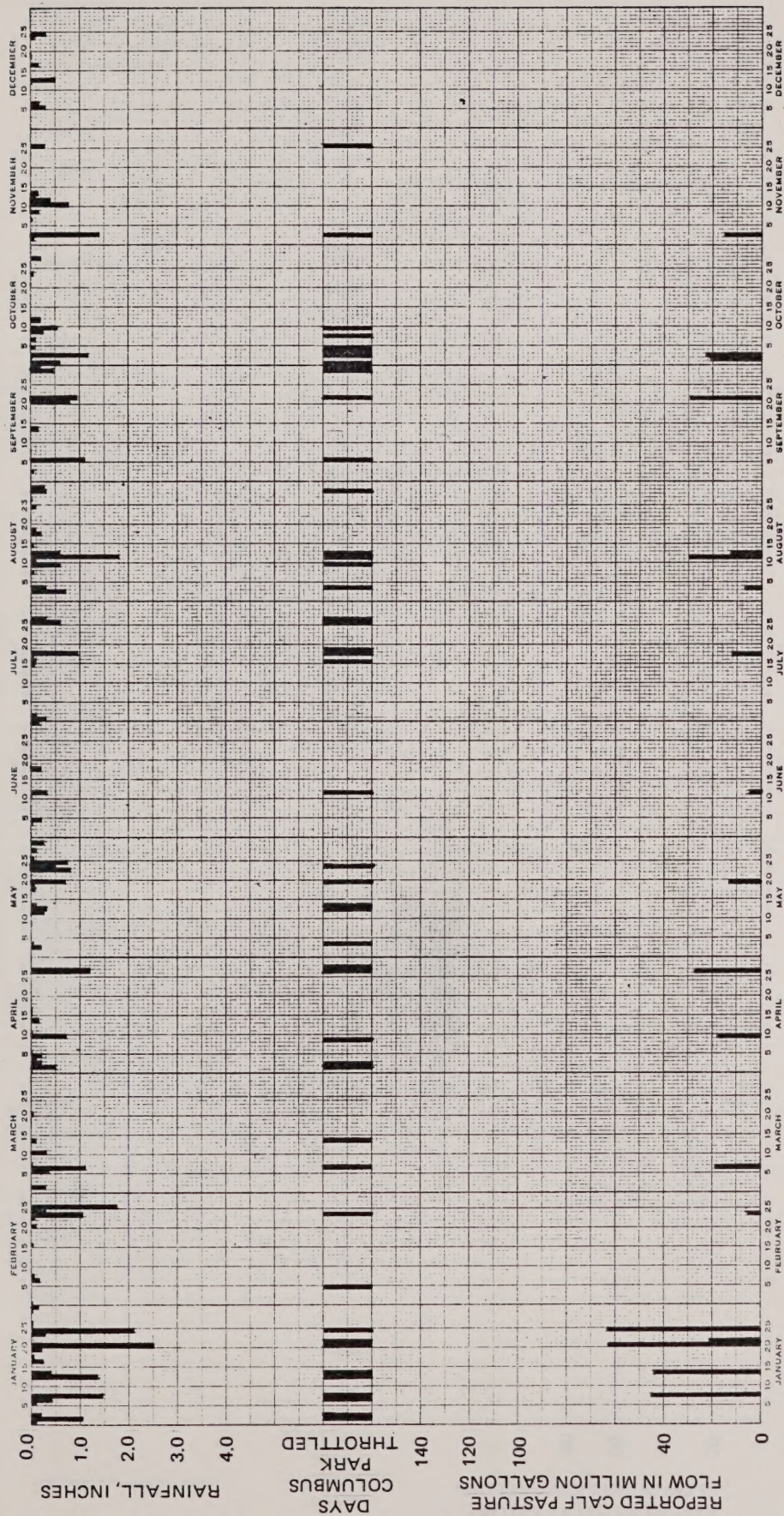


FIGURE E-15 CORRELATION BETWEEN RAINFALL, THROTTLING, AND PUMPING AT CALF PASTURE IN 1979

E-10 b

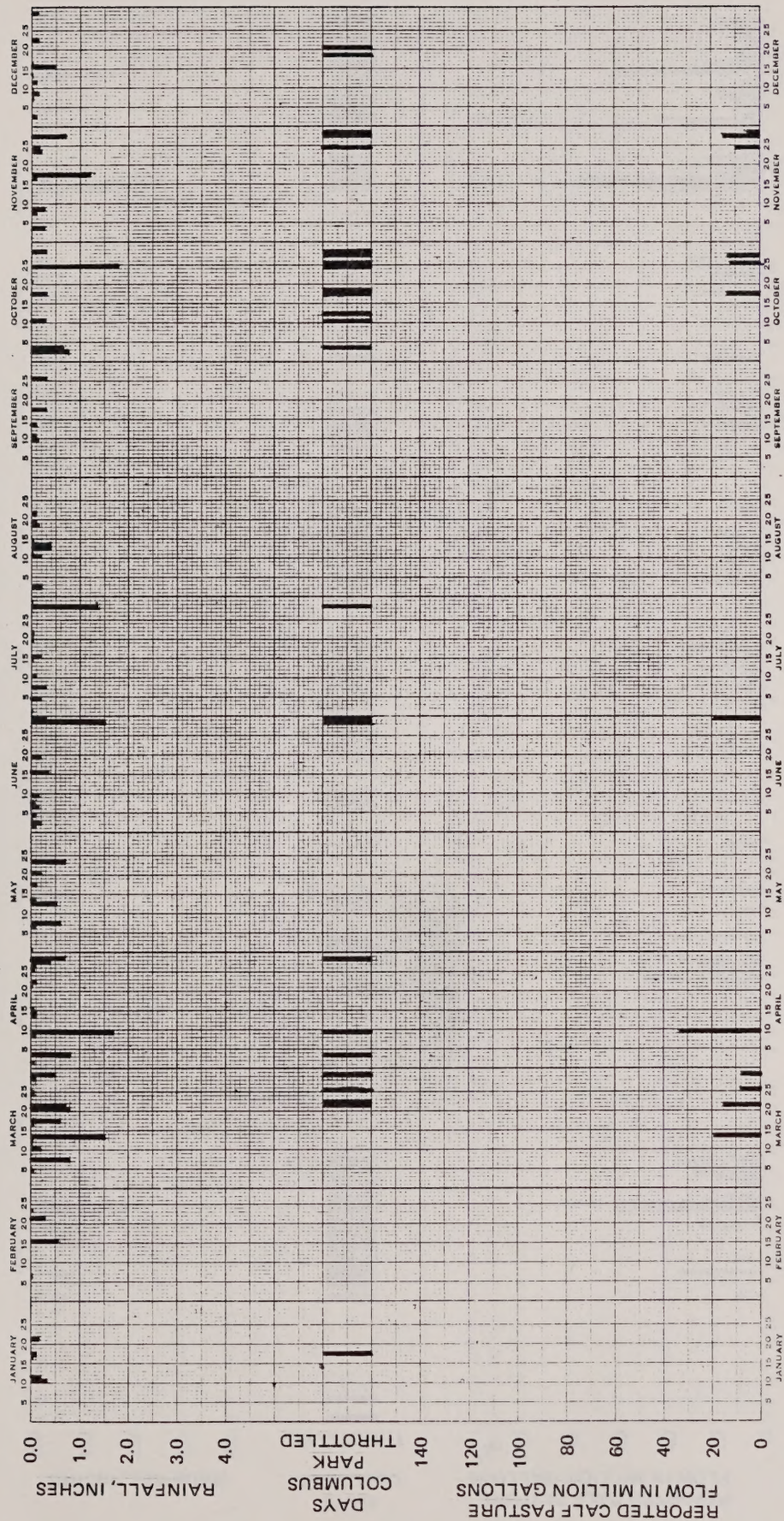


FIGURE E-16 CORRELATION BETWEEN TRAINFALL, THROTTLING, AND
PUMPING AT CALF PASTURE IN 1980

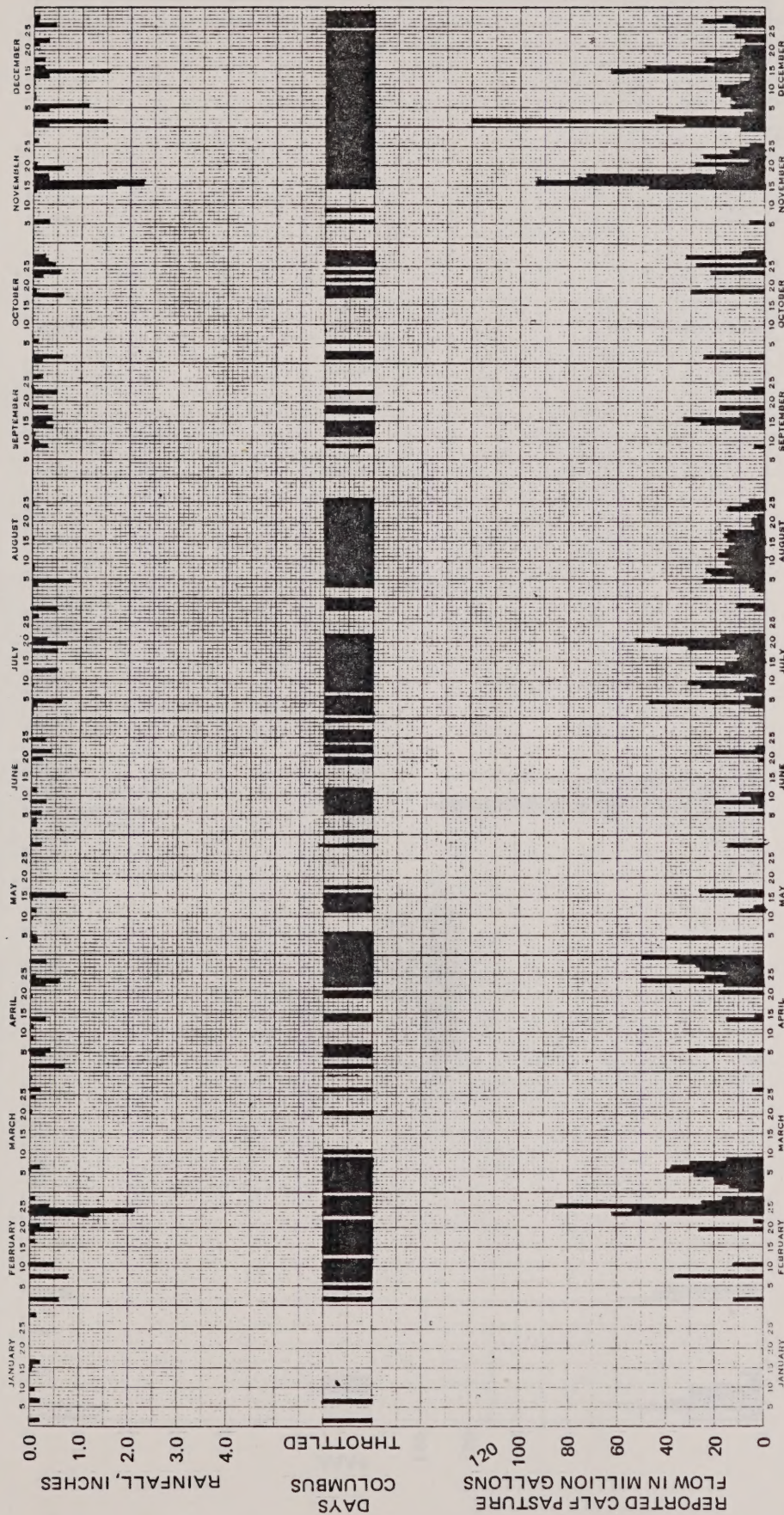


FIGURE E-17 CORRELATION BETWEEN RAINFALL, THROTTLING, AND PUMPING AT CALF PASTURE IN 1981

E-10

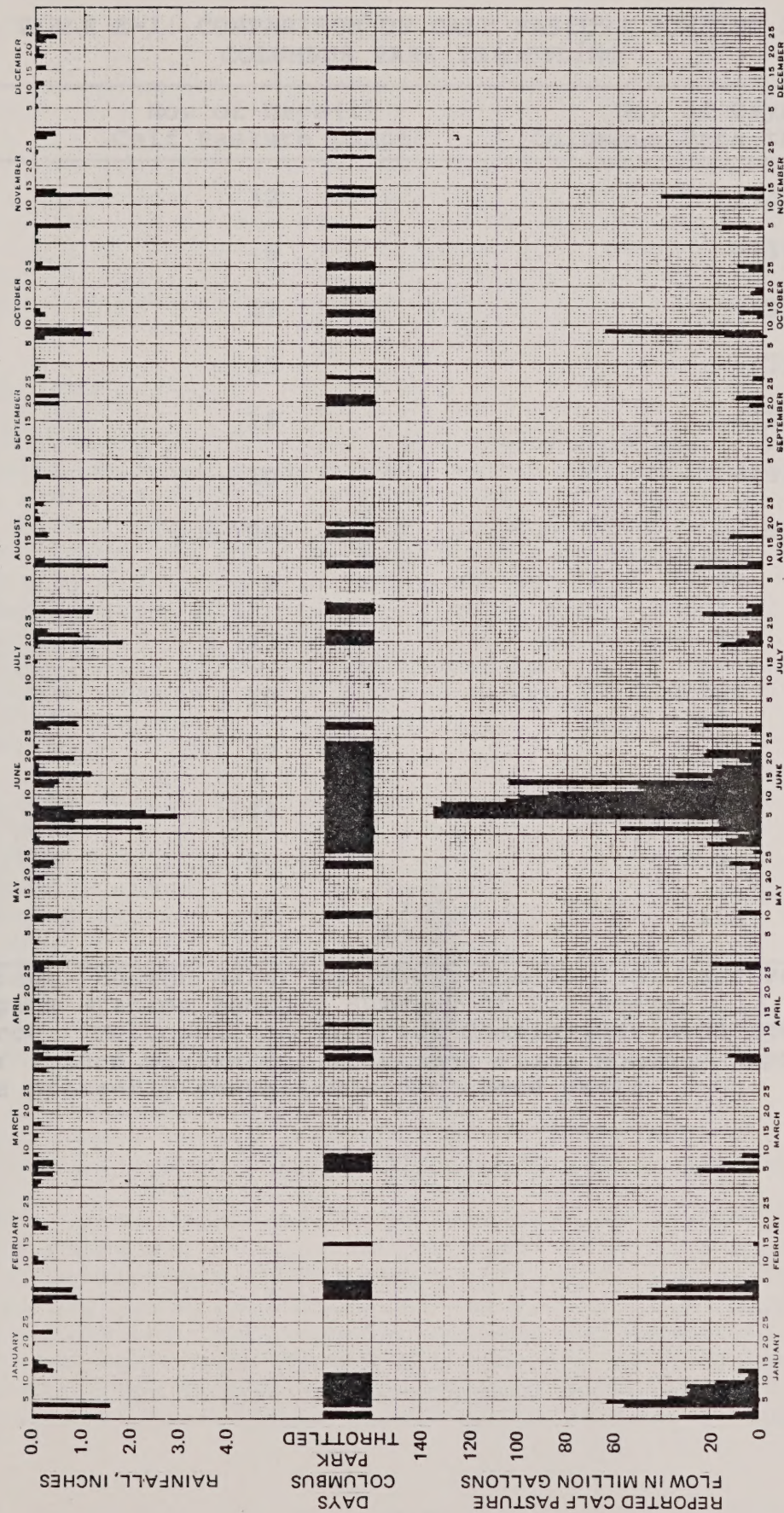


FIGURE E-18 CORRELATION BETWEEN RAINFALL, THROTTLING, AND PUMPING AT CALF PASTURE IN 1982

TABLE E-1. COMPARISON OF CALF PASTURE PUMPING AND
COLUMBUS PARK THROTTLING

Year	No. of Days(1) Calf Pasture pumped	No. of Days(2) Columbus Park throttling
1970	32	-(3)
1971	6	-(3)
1972	27	-(3)
1973	25	-(3)
1974	16	-(3)
1975	10	-(3)
1976	20	-(3)
1977	8	37
1978	13	27
1979	19	46
1980	12	25
1981	144	193
1982	82	94
1983	71	118

1. Source: Boston Water and Sewer Commission, Calf Pasture Pumping Station Monthly Summary of Discharges.
2. Source: Metropolitan District Commission, Sewerage Division, Deer Island Wastewater Treatment Plant Monthly Reports.
3. Data presently unavailable for these years.

ASSESSMENT OF FACILITIES

The Calf Pasture Pumping Station is just over 100 years old. It has been intermittently operated and maintained for the past fifteen years. As a result, the station is in considerable disrepair. As part of this analysis, the station was evaluated to assess the nature and extent of its deficiencies. The evaluation was conducted in two parts; one focusing on the hydraulic capacity of the station, and the other on its physical condition. This section presents the results of those evaluations.

Hydraulic Evaluation

The intent of the hydraulic evaluation was to determine the present capacity of the pumps within the pumping station and in turn estimate the total capacity of the pumping station. The station is not equipped with any flow measuring equipment. Flow discharged from the station is currently estimated by recording pump running time and multiplying the original rated capacity of each pump by the running time. As previously indicated, the pumps at the station are approximately fifty years old and are almost certainly not operating at their original rated capacity. Two methods were employed to determine existing pump capacity: (1) testing by representatives of the pump manufacturers; and (2) gaging station output.

Pump Tests. The testing of the pumps at the Calf Pasture Pumping Station involved field examinations and testing by Worthington Pump Corporation. Pumps number 1 through 4 and pump number 6 were manufactured by Worthington. Pump number 5 was manufactured by the Warren Pump Company. The goal of the testing program was to produce pump head - capacity curves which estimate the present performance of the pumps.

Representatives from Worthington, in conjunction with Metcalf & Eddy personnel, conducted the testing program on August 25, 1983. At the time of the tests, pump number 2 was out of service for repairs. Pump number 1 is no longer in service. The remaining pumps, number 3 through 6, were tested. The impellor in pump number 2 was examined and showed substantial wear.

The tests consisted of running each pump with its discharge valve set at various positions ranging from totally closed to totally open. For each position of the discharge valve the following items were measured and recorded: suction and discharge pressure, motor speed, voltage and amperage. The flow discharged by the pumps during the test was recirculated from the pipe chamber back to the pumping station galleries. This was accomplished by opening the discharge gate valve of one of the

pumps not being tested and allowing flow to return to the station from the pipe chamber through the force main and the pump.

Normally, pump testing procedures would require the measurement of flow rates in addition to other parameters. The Calf Pasture Pumping Station has no facilities for flow measurements, and no convenient means for measuring flow during the test could be arranged. Accordingly, the results of the testing program are projected performance curves based on the measured parameters and the observed physical condition of the pumps, as opposed to the actual performance curves that could be determined if flow rate measurements were available.

The original and adjusted pump rating curves developed from the field tests are included in Attachment 1 to this Appendix. Table E-2 presents a summary of the testing program results.

TABLE E-2. SUMMARY OF AUGUST 25, 1983
PUMP FIELD TEST PROGRAM RESULTS

Pump Number	Design Conditions		Test Results(2)	Percent Capacity Reduction
	TDH(1) (ft.)	Capacity (mgd)	Projected Capacity at Design TDH (mgd)	
1	38.5	32.8	Pump no longer in service	-
2	38.5	32.8	Pump out of service for repairs	-
3	38.5	32.8	23.6	28
4	38.5	32.8	30.8	6
5	42.0	41.8	35.3	16
6	42.0	37.4	29.5	21

1. Total dynamic head.
2. As determined from pump curves developed by Worthington Pump Company from field test data.

From the data in Table E-2, it can be seen that the pump capacities determined during the testing program are less than the original rated capacity. Based on the test results, and assuming that pump number 2 would test out similar to pump number 3, the total station capacity would be an estimated

140 mgd. This capacity must be adjusted downward however, because pump number 5 has had overheating problems and cannot be operated for more than several minutes. The reliability of pump number 4 is also in question since it has a bent shaft and vibrates excessively. Removing pump number 5 from the total capacity figure yields a best case station capacity, as predicted by the tests, of 105 mgd.

Gaging Program. The second approach to estimating the hydraulic capacity of Calf Pasture Pumping Station involved measuring the discharge from the station at the pipe chamber. As previously described, all flow from the pumping station is discharged to the pipe chamber prior to entering the deposit sewers and the Dorchester Bay tunnel.

For the purposes of this program, the entrances to the north deposit sewer and the bypass chamber were blocked so that all flow from the station would pass into the south deposit sewer. To allow flow measurement, an 8 foot long sharp crested weir consisting of a steel angle bolted to a stoplog was installed at the entrance to the south deposit sewer. Continuously recording depth of flow gages were installed as indicated on Figure E-19. The depth of flow gages indicated the time and duration of discharges from the station as well as the depth of flow over the weir. The discharge capacity was calculated using the Francis Equation, which for this application is as follows:

$$Q = 3.33 LH^{3/2}$$

where Q = Discharge in cubic feet per second (CFS)
L = Length of weir crest (feet)
H = Head on weir crest (feet)

Station discharge could therefore be calculated for any discharge event. Through coordination with station operating personnel, pumps were brought on line during discharge events in a way that allowed quantification of the capacity of all the operating pumps in the station.

The program was conducted from July through December of 1983. In all, twenty discharge events were recorded. Gage data was obtained for eighteen of the events. Table E-3 lists for each discharge event the capacity and volume of discharge as estimated by the gaging program and compares it to the capacities and volumes currently estimated by BWSC.

As indicated in Table E-3, discharges for all operating pumps were recorded during the program. The discharge rate for a particular pump varies for different discharge events due to the variation of the total pumping head. This total pumping head

TABLE E-3. CALF PASTURE FLOW GAGING PROGRAM RESULTS - 7/83 THROUGH 12/83

Pumping Event Date	Weather (1)	Pumps Operated as reported by BWSC	Pump(s) Running Time as Reported by BWSC (hours)	Flow Rate		Total Flow	
				Estimated by BWSC (mgd)	Gaged by M&E (mgd)	Estimated by BWSC (mg)	Gaged by M&E (mg)
8-29-83	Rain 0.22 inches	3	2.00	30	9.6	2.50	0.80
		3&6	4.00	75	9.6	12.50	1.60
						15.00	2.40
9-22-83	Rain 0.69 inches	3	4.50	30	9.6	5.60	1.80
10-13-83	Rain 0.97 inches	3	0.25	30	9.9	0.31	0.10
		3&6	1.50	75	20.4	4.69	1.27
		6	0.50	45	10.5	0.93	0.22
						5.90	1.59
10-23-83	Rain 0.54 inches	3	9.00	30	9.0	11.30	3.37
		6	8.75	45	11.4	16.40	4.16
						27.70	7.53
11-4-83	Rain 0.67 inches	3	3.00	30	9.0	3.75	1.12
11-10-83	Rain 1.15 inches	3	1.00	30	9.0	1.25	0.38
		3&5	0.50	75	14.5	1.56	0.30
		3	4.50	30	9.0	5.63	1.68
						8.44	2.36
11-16-83	Rain 1.69 inches	3	0.50	30	0.0	0.63	0.00
		3&4	2.25	60	18.8	5.63	1.76
		3,2,&4	0.25	90	15.7	0.94	0.16
		3&2	3.00	60	18.8	7.50	2.35
		2	1.00	30	4.7	1.25	0.20
						15.95	4.47
11-21-83	Rain 0.46 inches	3	4.00	30	8.0	5.00	1.33
		2	4.50	30	5.7	5.62	1.07
						10.62	2.40
11-25-83	Rain 2.76 inches	3	0.25	30	4.6	0.31	0.05
		3&2	1.50	60	19.8	3.75	4.12
		2,3&4	6.00	90	35.4	22.50	2.95
		2,3,4&6	8.00	135	46.5	45.00	15.50
		2,3&6	2.50	105	32.9	10.94	3.43
		3&6	1.75	75	20.9	5.47	1.52
		6	1.75	45	9.3	3.28	0.68
						91.25	28.25
11-26-83	Clear	3	7.75	30	6.1	9.70	1.97
11-28-83	Rain 0.53 inches	2	0.75	30	4.7	0.93	0.15
		2&3	8.00	60	16.7	20.00	5.56
		3	6.50	30	16.7	8.12	4.52
		3&6	1.00	75	22.0	3.12	0.92
						32.18	11.15
11-28-83	Clear	3	2.00	30	6.1	2.50	0.50
11-29-83	Clear	3	4.00	30	4.0	5.00	0.70
11-30-83	Clear	3	0.25	30	6.3	0.31	0.06
		2&3	1.75	60	17.9	4.37	1.30
		2	0.25	30	13.3	0.31	0.19
						5.00	1.55
12-4-83	Rain (2)	2&3	1.00	60	23.5	2.50	0.98
		2,3&6	3.25	105	33.2	14.22	3.18
		2&3	2.00	60	16.9	5.00	1.41
		2	0.25	30	0.0	0.31	0.00
		2&6	2.50	75	22.3	7.81	2.32
		6	1.00	45	10.3	1.88	0.43
						31.72	8.32

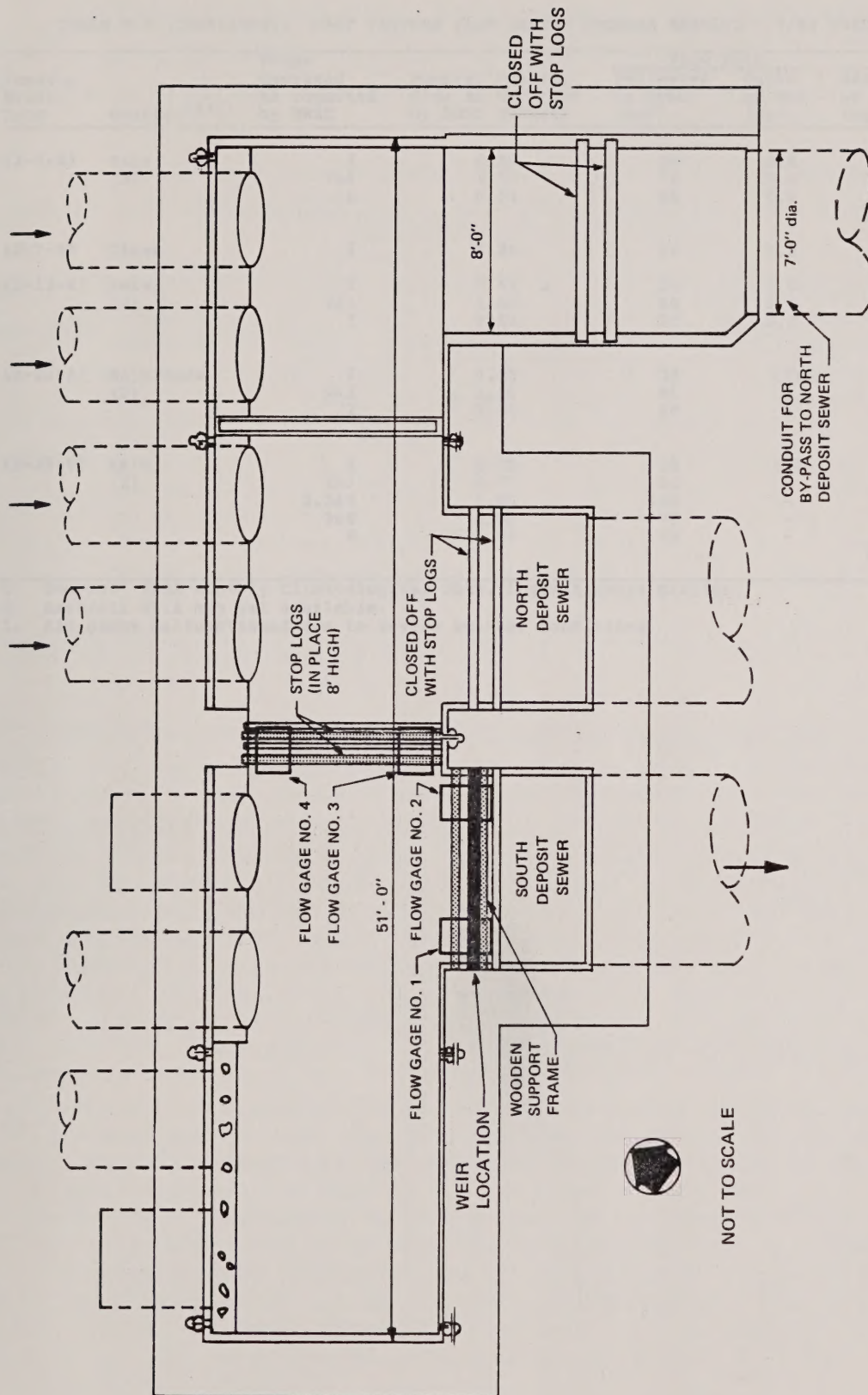


FIGURE E-19 PLAN OF FLOW GAGE LOCATIONS AT THE PIPE CHAMBER

E-16a

TABLE E-3 (Continued). CALF PASTURE FLOW GAGING PROGRAM RESULTS - 7/83 THROUGH 12/83

Pumping Event Date	Weather (1)	Pumps Operated as reported by BWSC	Pump(s) Running Time as Reported by BWSC (hours)	Flow Rate		Total Flow	
				Estimated by BWSC (mgd)	Gaged by M&E (mgd)	Estimated by BWSC (mg)	Gaged by M&E (mg)
12-7-83	Rain (2)	3	0.25	30	0.0	0.31	0.00
		3&6	3.50	75	25.8	10.94	4.30
		6	0.50	45	0.0	0.94	0.00
						12.19	4.30
12-7-83	Clear	3	6.25	30	7.0	7.81	1.80
12-13-83	Rain (2)	3	0.50	30	0.0	0.62	0.00
		2&3	1.00	60	8.6	2.50	0.70
		3	0.50	30	0.0	0.63	0.00
						3.75	0.70
12-22-83	Rain/Snow (2)	2	0.25	30	(3)	0.31	(3)
		2&3	1.50	60	-	3.75	-
		2	3.50	30	-	4.34	-
						8.40	-
12-28-83	Rain (2)	3	0.25	30	(3)	0.31	(3)
		2&3	0.75	60	-	1.88	-
		2,3&6	1.00	105	-	4.34	-
		3&6	0.50	75	-	1.56	-
		6	1.00	45	-	1.88	-
						10.00	-

1. Source: NOAA Monthly Climatological Data, Logan Airport Station.
2. Rainfall data not yet available.
3. All gages malfunctioned due to severe weather conditions.

variation is attributable to changes in static head resulting from variations in wet well levels.

Table E-4 summarizes the discharge rates determined for each pump from the gaging program.

TABLE E-4. SUMMARY OF JULY - DECEMBER 1983
GAGING PROGRAM RESULTS

Pump No.	Total gaged running time as reported by BWSC (hours)	Gaged Discharge Rate			Original Design Capacity (1) (mgd)
		Low (mgd)	High (mgd)	Average (mgd)	
2	47.50	4.7	15.2	9.9	32.8
3	109.25	4.0	14.1	8.5	32.8
4	16.50	4.7	15.6	11.3	32.8
5	0.50	5.5	5.5	5.5	41.8
6	40.50	5.3	11.6	10.5	37.4

1. Original design capacity at rated head.

From the results of the gaging program, it is clear that the Calf Pasture Pumping Station is actually discharging approximately 30 percent of the discharge volume that BWSC currently reports to the regulatory agencies. With the exception of pump number 5, it can be seen that each pump is discharging at a rate of approximately 10 mgd. Pump number 5 reportedly has problems with overheating and consequently had been operated only briefly during the gaging program. The data, therefore, is limited and the capacity of pump No. 5 is uncertain.

From the data in Table E-4, the total capacity of the station can be estimated at 46 mgd on average and a maximum of 62 mgd. Excluding pump number 5 because of its lack of reliability brings the estimate down to 41 mgd on average and a maximum of 56 mgd. A review of the data in Table E-3 indicated that the maximum rate of discharge estimated during the gaging program was 46.5 mgd. This capacity was reached with pumps number 2, 3, 4 and 6 in operation.

Summary of Findings. Table E-5 presents a summary of the results of both capacity estimating programs in comparison with rated capacities which are currently used by BWSC to estimate discharge.

TABLE E-5. COMPARISON OF CAPACITY ESTIMATES

Pump No.	Rated Capacity (mgd)	Field Test Capacity Estimates (mgd)	Gaging Program Capacity Estimates (mgd)	
			Average	Maximum
2	32.8	(1)	9.9	15.2
3	32.8	23.6	8.5	14.1
4	32.8	30.8	11.3	15.6
5	41.8	35.8	5.5	5.5
6	37.4	29.5	10.5	11.6

1. Not in service during field test.

Clearly, a considerable discrepancy exists between the results of the pump tests and the gaging program. Because the pump tests did not include flow measurements and the methods used in the gaging program were believed to be relatively simple and accurate, the results of the gaging program are considered to be more indicative of what the station is pumping. While the level of testing and inspection did not allow specific identification of why the pumps are performing as poorly as they seem to be, it is believed that the problem may be attributable to poor suction conditions. Specifically, it is suspected that the casing and suction piping of the pumps may be leaking air into the pumps and it is further suspected that the pump galleries may be cluttered with debris and limiting flow to the pumps. Both of these conditions could substantially limit pumping capacity. If these conditions were corrected, it is possible that the estimated pumping capacities predicted by the pump tests could be achieved.

It is therefore the conclusion of the hydraulic analysis that the station is currently capable of pumping a maximum of 56 mgd. This could be improved to 62 mgd if the overload problems with pump number 5 could be solved. Rehabilitating the pumps to correct their current capacity problems could improve the pumping capacity of the station to 105 mgd or possibly 140 mgd with an improved pump number 5.

Physical Evaluation

This assessment of the physical condition of the Calf Pasture Pumping Station involved a field inspection of the facilities by a team of technical specialists. The team included mechanical, heating and ventilating, electrical, and operations and maintenance specialists. The facilities were inspected in August, 1983. A structural evaluation of the pumping station was conducted by others under a separate contract.(1)

The purpose of the inspections was to assess the condition of the facilities with respect to operational requirements and present day safety standards. This section presents the findings of the field inspection team. Findings are presented separately for each of the major facilities considered.

Screen House. The only mechanical equipment in the screen house is the sluice gate which controls the influent to the station. There are currently no screens in the screen house. The original cage type screens have been removed and never replaced. Much of the original hoisting equipment associated with the original cages, although useless, has been left in place. The absence of screens poses a threat to the operation of the station in that no protection is being provided to the pumps from debris in the influent. This problem is particularly significant problem in terms of the reliable operation of the facility given the age and the condition of the pumps.

The cylinder operator for the timber sluice gate has been removed and an electric hoist has been installed to operate the gate. The hoist is attached to a beam resting on the old hoisting mechanisms for the screens. At times the gate does not close when lowered and a makeshift frame has been installed so that the gate can be seated using a jacking mechanism. The gate itself leaks so that the pumping station cannot be isolated from the influent sewer. As a result, flooding of the station to the level of the bases of the pump motors on pumps number 2 and 4 has occurred in the past. Because the screen house is functionally a wet well, it should be continuously ventilated when occupied. There is no mechanical ventilation or heating in the building.

Based on its function, the building should also be protected from explosion hazards. It was noted during the field inspections that the ceiling of the building was damaged by fire. Conversations with operating personnel indicated that the fire damage resulted from a previous explosion. Since the explosion, lighting switches have been located outside of the

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1. Weidlinger Associates, Calf Pasture Pumping Station - Preliminary Report. Boston Water and Sewer Commission, December 1983.

building to limit the explosion hazard. The electric hoist is not explosion proof and it is still located in the building. The existing lighting is inadequate and the power outlets are in poor condition. Neither the lighting nor the power outlets are explosion proof.

The station is not equipped with emergency power. There is no emergency lighting.

An operational consideration is the condition of the floor decking. This is addressed in the previously cited structural evaluation report.

Pumping Station. The major mechanical equipment in the pumping station, its manufacturer, age, size/capacity, and condition are listed in Table E-6. This equipment is generally in poor condition. The sluice gates at each end of the five sewage cross galleries are no longer operable. The gates were DC motor driven, but the motors were subjected to flooding when the sewage galleries surcharged and were subsequently removed. Without the sluice gates, the cross galleries cannot be isolated for dewatering and cleaning. Each pump has a motor driven discharge gate valve, which are known to leak. The operators for the valves for pumps number 1 through 4 are in fair condition.

The sewage pumps are all approximately fifty years old and are in poor condition. There are no screening devices ahead of the pumps to prevent large objects from entering and damaging the pumps. The motor for pump number 1 was damaged by flooding and subsequently removed. At the time of the inspection, the casing for pump number 1 was being repaired with metal repair compound. The casing on pump number 2 is worn and damaged beyond repair and was to be replaced with the casing from pump number 1. The casings on pumps 3, 4, 5 and 6 have also been repaired with metal repair compound indicating that the casings are in poor condition.

It was reported by operating personnel that they experienced trouble priming the pumps. The field inspection indicated that the vacuum priming system is in fair to poor condition. The priming problems are more than likely due to the condition of the priming system and the probable leaks in the suction piping. Pump number 6, which is especially difficult to prime, has visible external repairs to the suction nozzle.

The estimated remaining useful life of each of the pumps is five years with the exception of pump number 5 which was rebuilt in 1982 and appears to be in fair condition with a life expectancy of five to ten years.

TABLE E-6. LIST OF MAJOR EQUIPMENT AT THE CALF PASTURE PUMPING STATION

Equipment	Manufacturer	Age	Size/Capacity	Condition
Power Transformers(2)	Unknown	Unknown	1,200 kva	Good
Motor Control Centers(3)	Square D Co.	3 yrs.	-	Good
Motor Starters(2)	Firetrol Co.	4 yrs.	-	Fair
Main Sluice Gate	Rodney-Hunt Co.	25 yrs.	5'-9"x6'-0"	Good
Pumps - No. 1	Worthington Co.	45 yrs.+	32.8 mgd @ 38.5' tdh	Poor - Used for parts
No. 2	Worthington Co.	45 yrs.+	32.8 mgd @ 38.5' tdh	Poor
No. 3	Worthington Co.	45 yrs.+	32.8 mgd @ 38.5' tdh	Poor
No. 4	Worthington Co.	45 yrs.+	32.8 mgd @ 38.5' tdh	Poor
No. 5	Warren Pump Co.	52 yrs.+	41.8 mgd @ 42' tdh	Poor
No. 6	Worthington Co.	49 yrs.+	37.4 mgd @ 42' tdh	Poor
Motor Nos. 2, 3, 4	Westinghouse Co.	45 yrs.+	275 hp, 580 rpm	Fair
Motor No. 5	Westinghouse Co.	52 yrs.	350 hp, 350 rpm	Fair
Motor No. 6	Allis-Chalmers	49 yrs.	350 hp, 350 rpm	Fair
Gate Valves/Motor Operators(4)	Unknown	Unknown	30"/A.C. Motor	Fair
Gate Valves/Motor Operators(2)	Chapman/Unknown	Unknown	36"/D.C. Motor	Poor
Bridge Crane	Unknown	49 yrs.	10 Ton	Good
D.C. Motor - Generator Set	Unknown	23 yrs.	30 kw	Fair
Compressor	Unknown	Unknown	Unknown	Fair
Vacuum Pump/Motor	Nash Co./Westinghouse	Unknown	3"x2"/7-1/2 hp, 870 rpm	Fair
Vacuum Pump/Motor	Nash Co./Lincoln Co.	Unknown	Unknown/3 hp, 1,745 rpm	Fair

Also considered in the inspection program was the overhead bridge crane that services pumps number 5 and 6. It appears to be in good condition, but should be tested to determine current capabilities. The 30 kilowatt motor generator set used to provide DC power is in good operating condition. The motor driven air compressor unit for general plant air appears to be in fair condition. There is no equipment for flow measurement in the station. The existing float type wet well level indicator is in poor condition.

As with the screen house, the configuration of the pumping station is such that it is considered a wet well for ventilation purposes. It must be continuously ventilated when occupied. Also, building codes require that toilets and shop areas be ventilated. There is no mechanical ventilation in the station. The majority of the station is not heated. Key areas, such as the operator's office, the toilet area, and the vacuum priming pumps, have been enclosed and insulated with heat provided by small electrical space heaters. Key conduits such as vacuum priming and service water lines are heat traced to prevent freezing. The remains of the old steam heating system, including seven unit heaters, are in place, but no boiler exists to provide steam.

The electrical equipment at the station appears to be in better condition than the mechanical equipment. The two transformers that supply power to the station have been maintained and are in good condition. The original motor control centers (MCC's) for the pumps have been replaced by the BWSC with up-to-date equipment. Presently the new MCC's are being fed through portions of the old open bus bar system. The existing lighting is inadequate and not in keeping with current practice. No emergency lighting of any kind exists. None of the electrical equipment is of the explosion proof type as would be required under present day standards for wet well areas. The pump motors appear to be in fair condition. When a pump is out of service for any length of time, the motor is normally sent out for an overhaul. While the motor is out, new conduits and cables are run from the MCC's to the motors. This work is being done in stages and is not yet completed.

There are numerous conditions in the station that are unsafe from an operational perspective. The sewage galleries, considered a hazardous environment due to the presence of sewer gases, are open to the rest of the pumping station. Normally such hazardous areas would be physically separated from the rest of the pumping station and suitably ventilated. The cast iron floor and stairs are corroded in many places and should be inspected for structural integrity. The safety railings around floor openings are broken in many places and appear to be unsafe. As a result of inadequate maintenance, there is an excessive amount of debris strewn around the interior of the station. In addition, there are many open pipes and conduits,

exposed wires, and electrical enclosures that appear to be dead and should be removed. The potable water service, including backflow preventer, appeared to be in poor condition, but has been replaced since the inspections were made. There are no shaft guards on any of the pumps to prevent accidental injury. There are no screens over openings in the motors to prevent foreign objects from entering the motors. There is no safety cage surrounding the exposed open bus bar system behind the motor control centers. There is no overhead bridge crane to service the horizontal pumps.

Pipe Chamber. There are four wooden flap valves in the pipe chamber, two of which are in poor condition and two which are in good condition. The safety railing around the chamber is broken in many places and is unsafe. The security fence surrounding the chamber is in poor condition and should be replaced. There is no lighting at the pipe chamber and there is no safety grating over the chamber.

Summary of Findings. The deficiencies identified in the Calf Pasture Pumping Station as a result of the inspection by the technical specialists are summarized as follows:

- . The pumps and associated piping are in poor condition.
- . There are no screens ahead of the pumps.
- . The main influent sluice gate leaks.
- . There is no separation between the sewage galleries (wet well) and the remainder of the station.
- . There is a lack of heating and ventilating in occupied areas.
- . Lighting in the Screen House and Pumping Station is inadequate, and non-existent at the Pipe Chamber.
- . Safety devices such as railings and shaft guards are either non-existent or in poor condition.
- . The vacuum priming system does not have sufficient capacity to satisfactorily prime the pumps.
- . There is no equipment for measuring and recording the flow discharged from the station.
- . The pump discharge gate valves and operators are in poor operating condition.
- . Electrical equipment and lighting is not of explosion proof design.
- . The wet well level indicator is in poor condition.

ASSESSMENT OF FUNCTION

Consideration for abandoning the Calf Pasture Pumping Station centers upon an assessment of the relevance of the function it performs. This section evaluates the relevance of the following functions normally attributed to the station: prevention of street flooding and back-ups into building connections, and prevention of near shore overflows resulting from flow restrictions at the MDC's Columbus Park headworks. Conclusions as to need are also summarized and presented.

Street Flooding and Backups

The system tributary to the Calf Pasture Pumping Station is combined and as such has the dual responsibility of: 1) transporting wastewater to Deer Island for treatment; and, 2) disposing of storm water to receiving waters. The distinction between these two functions is made at a flow divider, or regulator, which allows a restricted amount of flow to pass to the combined interceptor for transport to the treatment facilities and allows higher flows, stormflows, to pass on to a combined sewer overflow. Figure E-20 presents a sketch which illustrates this concept.

As indicated on Figure E-20, flow from the combined sewer areas first flows to the combined interceptor. Once the capacity of the interceptor system is reached, flow begins to back up in the regulator manhole and pass to the overflow. At this point, the depth of flow in the regulator manhole (hydraulic grade) builds up as required to allow the flow tributary to it which can not be handled by the interceptor system to be discharged to the receiving surface water. When overflows are occurring, the hydraulic grade at the regulator manhole is equal to the elevation of the receiving water surface (static head) plus the height of water necessary to allow the quantity of overflow to pass through the overflow conduit system (friction head).

The key factor in assessing the role of the Calf Pasture Pumping Station on street flooding and building backups is its impact on the hydraulic grade at the regulator manholes in the system.

The Calf Pasture Pumping Station adds to the capacity of the interceptor network and as such reduces the quantity of near shore overflow that will occur for any given storm. This reduces the friction head required to allow the remaining quantity of overflow to pass through the overflow system and reduces the hydraulic grade required at the regulator manhole. In the Calf Pasture tributary system this impact is believed to be negligible. The principal determinant of the hydraulic grade at

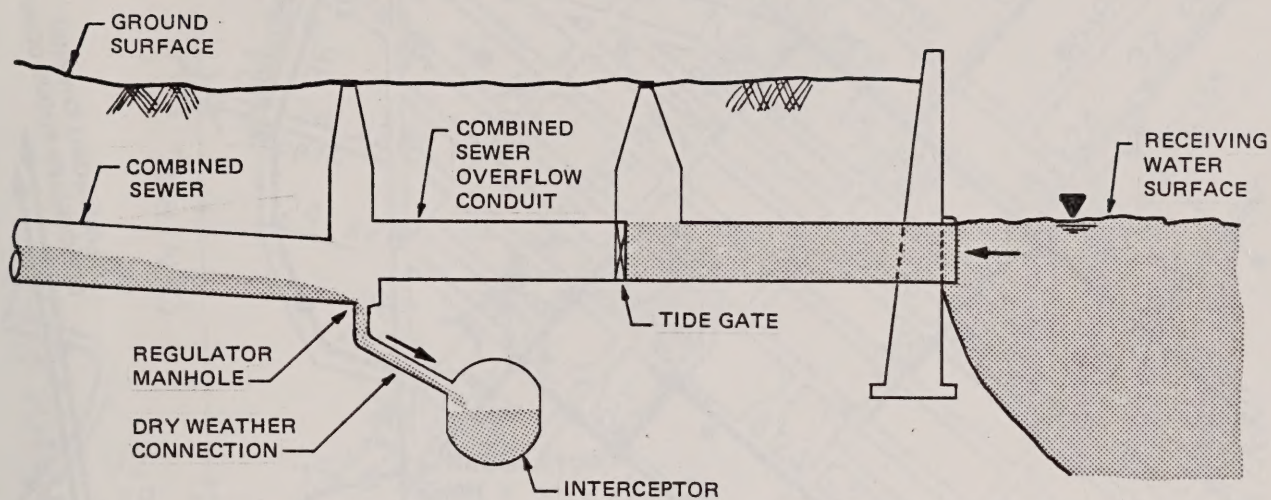
the regulators is the static head as set by the receiving watertidal elevation. In most cases, the friction head is not significant. Therefore, any reduction in friction head that might be accomplished by the operation of Calf Pasture Pumping Station would not be significant in terms of street flooding and backups.

To test this belief, a low lying area served by combined sewers and located within the Calf Pasture tributary area was investigated. The area selected for investigation is in South Boston. The wastewater needs of the area are served by the North Branch of the South Boston Interceptor. Stormwater overflows from the area discharge to Fort Point Channel. Figure E-21 shows the area and major sewers serving the area. Three hydraulic analyses to determine the hydraulic grade at the B Street regulator were performed. The first analysis assumed that all the flow from a five-year storm went to the overflow. The second assumed that a portion of storm flow, including an allowance for pumping from Calf Pasture, was taken by the interceptor system. The third analysis assumed that a portion of the storm flow was taken by the interceptor system without an allowance for Calf Pasture Pumping Station.

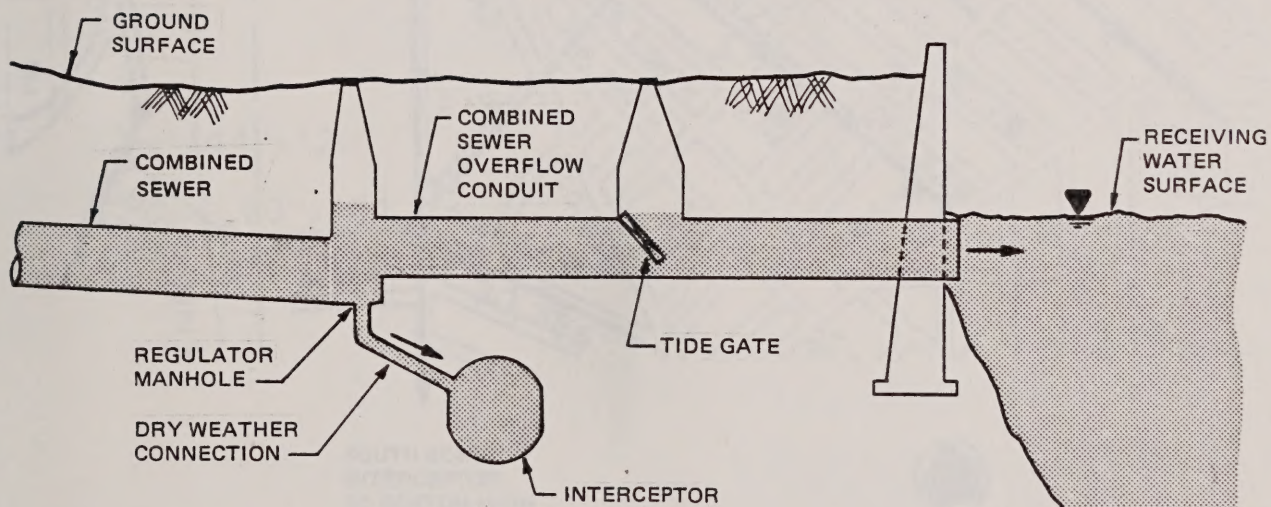
To assure a conservative analysis it was assumed that the interceptor system could carry a theoretical maximum flow of 330 mgd (million gallons per day). This was derived by assuming that the Columbus Park headworks could take 180 mgd and that the Calf Pasture Pumping Station could take 150 mgd. A portion of the total capacity of the interceptor system was allocated to the North Branch of the South Boston Interceptor in proportion to the area served. The allocation for the B Street regulator in the area being investigated was five mgd. All of the analyses were performed assuming a mean high tide elevation of +10.60 Boston City Base (BCB). Figure E-22 presents a flow schematic indicating the flow assumptions and allocations used in the analyses.

Figure E-23 presents a sketch of the B Street regulator and indicates the results of the analyses. As shown on this figure, the hydraulic grade at the regulator was reduced by only 0.05 feet with the interceptor system including the pumping station involved, and that only 0.02 feet of that reduction can be attributed to the Calf Pasture Pumping Station.

This investigation supports the basic contention that the Calf Pasture Pumping Station does not perform a relevant function with respect to the prevention of street flooding and backups into building connections. Another regulator, which is associated with the Dorchester Brook system, was also evaluated. In this case, the head differential at the regulator that could be attributed to the Calf Pasture Pumping Station was estimated at 0.30 feet. This was also considered insignificant. While it is possible that the hydraulics of a specific situation may produce



DRY WEATHER CONDITIONS



WET WEATHER CONDITIONS

FIGURE E-20 OPERATION OF A TYPICAL COMBINED SEWER REGULATOR



TO THE
OFFICE OF THE
DIRECTOR
OF THE
BUREAU OF
LANDS

REPORT OF THE DIRECTOR OF THE BUREAU OF LANDS

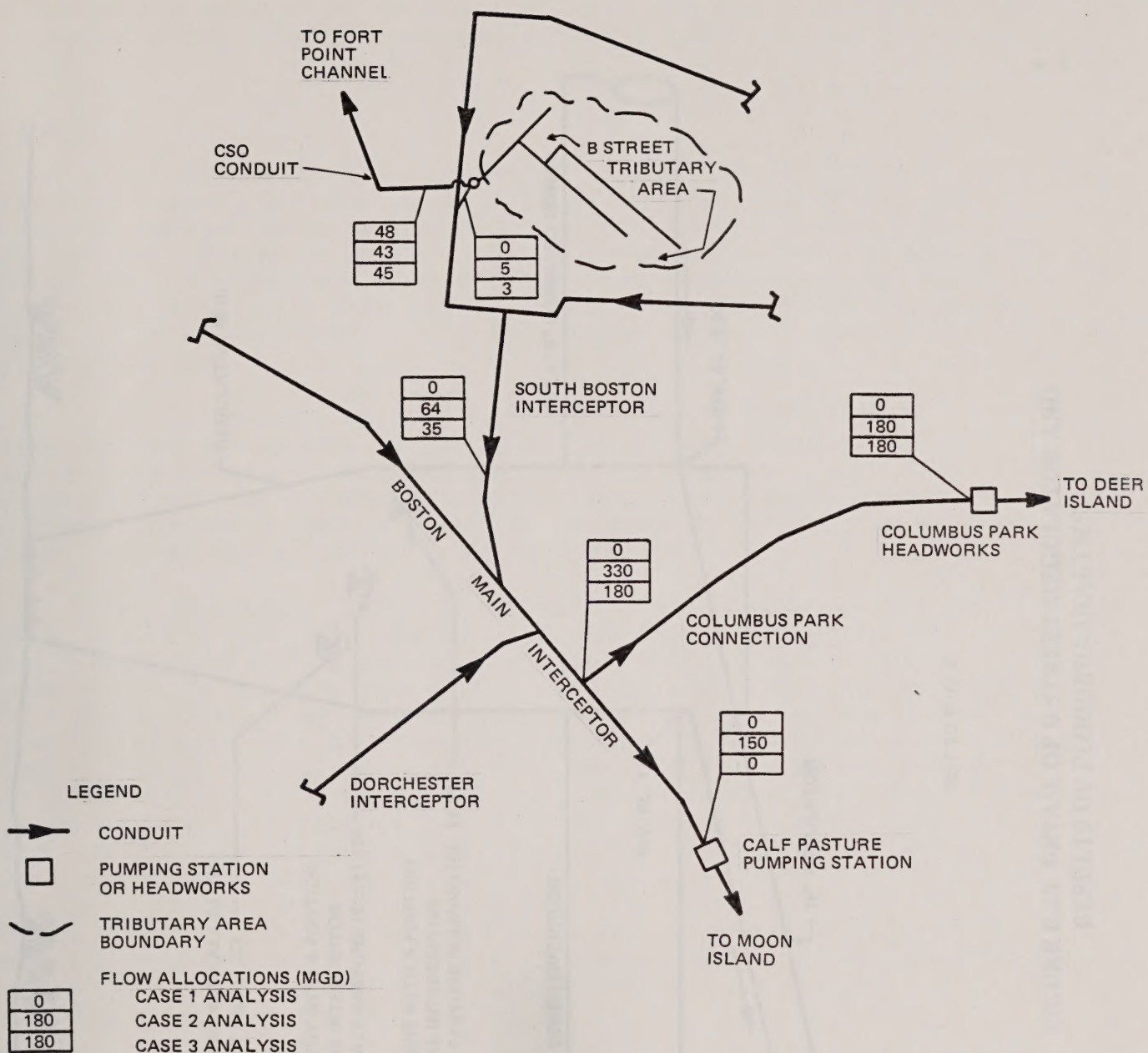


FIGURE E-22 FLOW SCHEMATIC INDICATING FLOW ALLOCATIONS USED IN FLOODING ANALYSIS

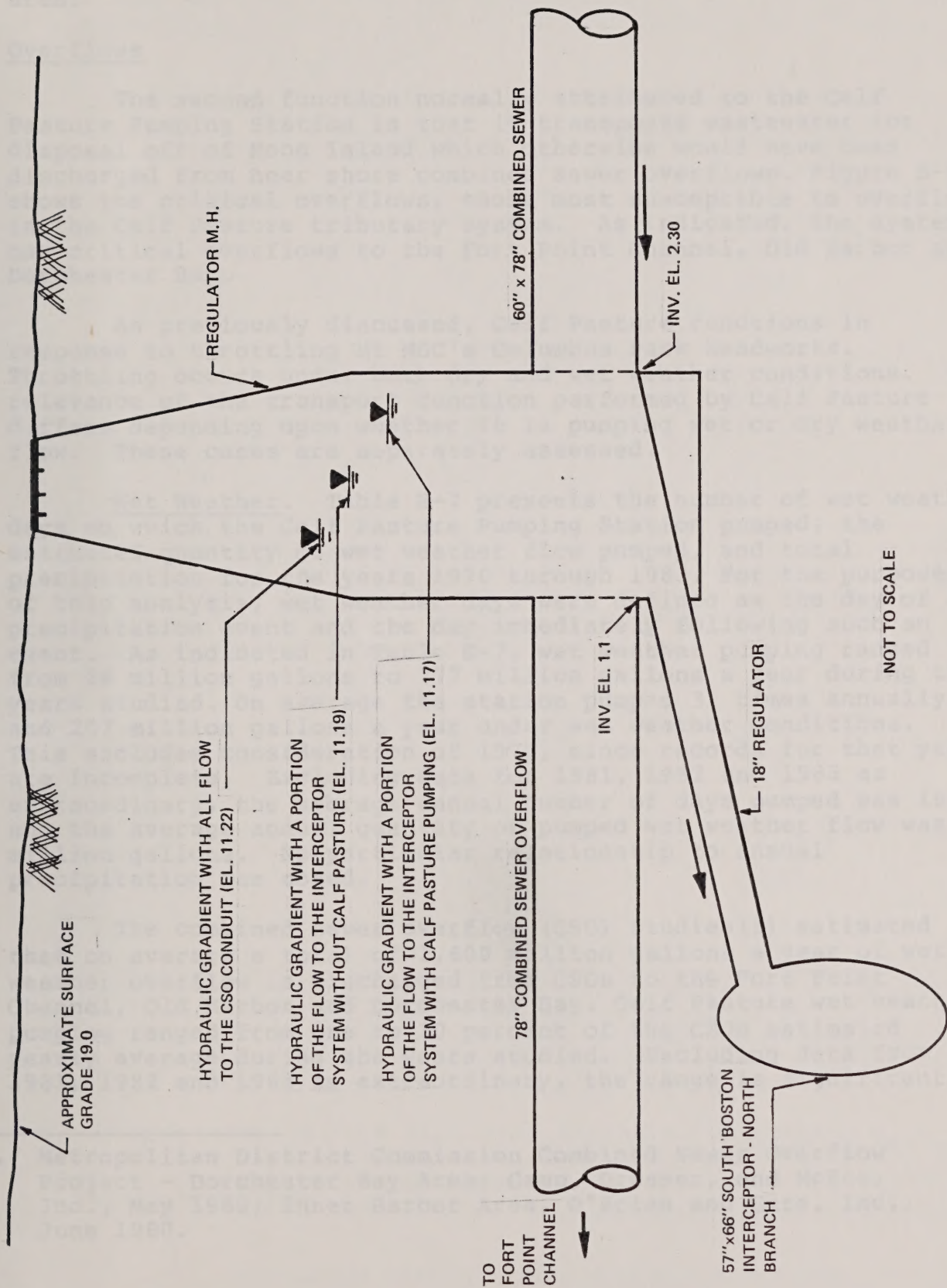
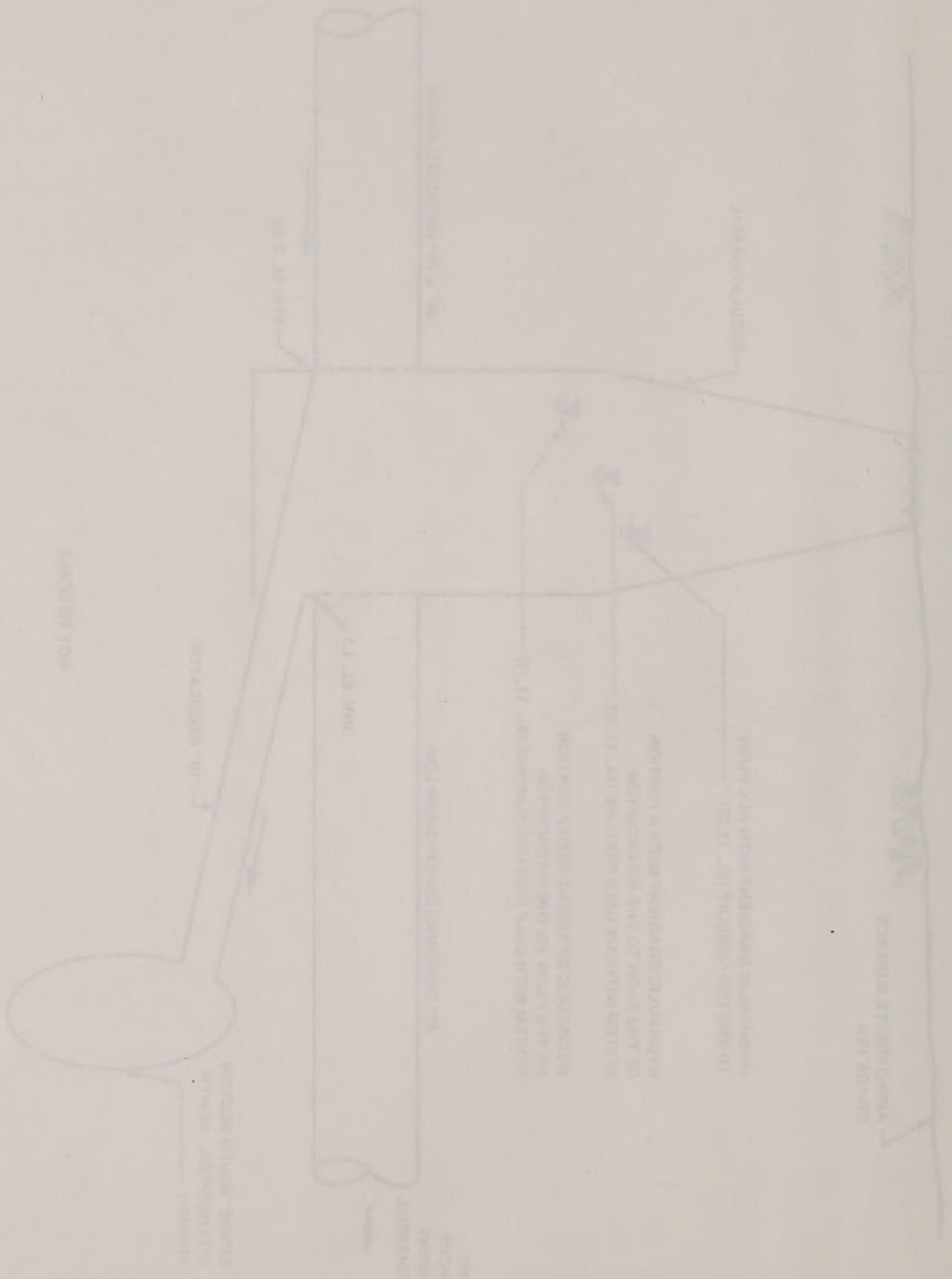


FIGURE E-23 DETAIL OF B STREET REGULATOR AND
RESULTS OF FLOODING ANALYSIS

E-26d

SECTION 12 OF 12 - 1977 12-12-1977



a different answer, it is believed that the conclusions of these analyses are generally applicable to the Calf Pasture tributary area.

Overflows

The second function normally attributed to the Calf Pasture Pumping Station is that it transports wastewater for disposal off of Moon Island which otherwise would have been discharged from near shore combined sewer overflows. Figure E-24 shows the critical overflows, those most susceptible to overflow, in the Calf Pasture tributary system. As indicated, the system has critical overflows to the Fort Point Channel, Old Harbor and Dorchester Bay.

As previously discussed, Calf Pasture functions in response to throttling at MDC's Columbus Park headworks. Throttling occurs under both dry and wet weather conditions. The relevance of the transport function performed by Calf Pasture differs depending upon whether it is pumping wet or dry weather flow. These cases are separately assessed.

Wet Weather. Table E-7 presents the number of wet weather days on which the Calf Pasture Pumping Station pumped, the estimated quantity of wet weather flow pumped, and total precipitation for the years 1970 through 1983. For the purposes of this analysis, wet weather days were defined as the day of a precipitation event and the day immediately following such an event. As indicated in Table E-7, wet weather pumping ranged from 26 million gallons to 777 million gallons a year during the years studied. On average the station pumped 31 times annually and 207 million gallons a year under wet weather conditions. This excludes consideration of 1975, since records for that year are incomplete. Excluding data for 1981, 1982 and 1983 as extraordinary, the average annual number of days pumped was 16 and the average annual quantity of pumped wet weather flow was 92 million gallons. No particular relationship to annual precipitation was noted.

The combined sewer overflow (CSO) studies(1) estimated that on average a total of 2,600 million gallons a year of wet weather overflow is discharged from CSOs to the Fort Point Channel, Old Harbor and Dorchester Bay. Calf Pasture wet weather pumping ranged from one to 30 percent of the CSOs estimated yearly average during the years studied. Excluding data from 1981, 1982 and 1983 as extraordinary, the range is significantly

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1. Metropolitan District Commission Combined Sewer Overflow Project - Dorchester Bay Area; Camp, Dresser, and McKee, Inc., May 1980; Inner Harbor Area, O'Brien and Gere, Inc., June 1980.

reduced to one to six percent. Comparing the average annual pumping of wet weather flow from Calf Pasture, exclusive of 1981, 1982 and 1983 data, to the annual CSO estimate indicates that the amount pumped from Calf Pasture is only 3.5 percent of the total.

TABLE E-7. CALF PASTURE WET WEATHER PUMPING HISTORY

Year	Reported Annual Precipitation(1) (inches)	Wet Weather Pumping	
		Number of days pumped	Total pumped flow(2) (million gallons)
1970	41.91	23	118
1971	35.67	6	26
1972	53.15	27	148
1973	42.79	25	139
1974	40.24	16	87
1975(3)	45.82	10	57
1976	36.76	17	78
1977	44.21	8	44
1978	37.67	9	65
1979	44.20	19	154
1980	29.39	12	56
1981	35.71	104	777
1982	44.61	70	631
1983	53.60	62	364

1. NOAA Annual Climatological Data, Logan Airport Station.
2. Adjusted from reported pumped flow based on August 25, 1983 gaging program results.
3. Calf Pasture discharge data incomplete for 1975.

This comparison indicates that Calf Pasture does play a role in the disposition of wet weather overflows from the combined system. While the relevance of this role was not directly assessed in this analysis, it has been the subject of



**FIGURE E-24 CRITICAL COMBINED SEWER OVERFLOWS
IN THE CALF PASTURE TRIBUTARY SYSTEM**

consideration in other recent studies. In 1976, the EMMA Study(1) suggested that the outlet works of which Calf Pasture is a part, be investigated for potential use in the interest of combined sewer overflow regulation. The CSO Study for the Dorchester Bay Area(2) considered this suggestion in some detail concluding that there were other more cost effective approaches to combined sewer overflow regulation in this area. The CSO study was specific with respect to the future need for Calf Pasture Pumping Station. It stated:

At present, the City of Boston's Calf Pasture Station is used during certain storm events to relieve the Columbus Park headworks of excess wet weather flow. Under the recommended plan, which includes restoration of pumping capacity to design conditions at the Deer Island Pumping Station, the Calf Pasture Pumping Station could be phased out of service.(3)

Based upon this finding of the CSO study, it has been concluded that the use of the Calf Pasture Pumping Station in the interest of CSO regulation will not be required when pumping capacity at the MDC Deer Island treatment plant is restored to design conditions and other aspects of the recommended plan for CSO control are implemented.

Improvements to the Deer Island wastewater treatment facilities are required by Procedural Order of the Superior Court of Massachusetts.(4) The Procedural Order includes a timetable for the immediate upgrade of the facilities at Deer Island which includes addressing the influent pump problem. The timetable stipulates that the Facility Plan for the improvements was to be completed by November, 1983 and that the improvements are to be completed within 55-1/2 months thereafter. This assumes that an Environmental Impact Report (EIR) will not be required, but allows an additional eight months if an EIR is required. A recently released (January 1984) Environmental Notification Form

1. Metcalf & Eddy, Inc., Wastewater Engineering and Management Plan for Boston Harbor - Eastern Massachusetts Metropolitan Area EMMA Study. Metropolitan District Commission, March 1976.
2. Camp, Dresser & McKee, Inc., Metropolitan District Commission Combined Sewer Overflow Project - Dorchester Bay Area. Metropolitan District Commission, May 1980.
3. Op. cit. Appendix B, page 7.
4. City of Quincy, Plaintiff, Procedural Order, Commonwealth of Massachusetts, Norfolk, SS, Superior Court, Dept. of the Trial Court CA. No. 138477, Metropolitan District Commission, Et. Al. Defendants.

for the Deer Island immediate upgrade improvements estimates completion by April, 1988.(1) Based on the Procedural Order it is assumed that the improvements necessary to Deer Island that would allow the abandonment of Calf Pasture from the standpoint of CSO regulation will be accomplished within five years or by April of 1988.

A proposed schedule for the completion of the CSO facilities in the Calf Pasture tributary system is contained in the Proposed Capital Program for MDC Sewerage. This program, described in a document recently released by the Massachusetts Executive Office of Environmental Affairs,(2) is divided into three phases based on each project's expected water quality benefits and design/construction duration. The CSO regulation facilities in the Calf Pasture tributary system have been distributed among the three phases. The majority of the CSO facilities are scheduled under Phases I and II which are to be completed in five and seven years respectively. Phase III is scheduled for completion in ten years. All of the CSO facilities recommended in the MDC CSO study would be operational with the completion of Phase III projects. This would allow the abandonment of Calf Pasture from the standpoint of CSO regulation. The completion dates given in the aforementioned documents are estimates. It is assumed that the starting point for the completion time is January 1984.

There is, however, some question as to whether the operation of the Calf Pasture Pumping Station is contributing to the control of CSO pollution to a point where its continued use is justified. This question involves determination of water quality impacts of CSO's in various locations in the Harbor, with and without pumping from the Calf Pasture Pumping Station. This determination is not within the scope of this analysis. It is therefore recommended that this issue be further studied. The station should continue to provide the wet weather function it now performs until such time as the facilities that would allow its abandonment are put into operation or further study indicates that the wet weather function it performs is not significant. Since the use of the station as part of the CSO regulation plan has not been recommended, improvements to the station for this purpose are not warranted.

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1. Metropolitan District Commission, Sewerage Division, Deer Island Fast Track Improvements - Environmental Notification Form. January 1984.
 2. The Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Proposed Capital Program for MDC Sewerage, A Synopsis. February 27, 1984.

Dry Weather. Table E-8 presents the number of dry weather days on which Calf Pasture pumped and the quantity of dry weather flow pumped for the years 1970 through 1983. For the purposes of this analysis, dry weather pumping days have been defined as days on which Calf Pasture pumped and no precipitation was recorded for both that day and the preceding day.

TABLE E-8. CALF PASTURE DRY WEATHER PUMPING HISTORY

Year	Dry Weather(1) Pumping	
	Number of days pumped	Total pumped flow(2) (million gallons)
1970	9	36
1971	0	0
1972	0	0
1973	0	0
1974	0	0
1975(3)	0	0
1976	3	8
1977	0	0
1978	4	20
1979	0	0
1980	0	0
1981	40	196
1982	12	111
1983	9	31

1. Dry weather is defined as two (2) consecutive days without measureable rainfall.
2. Adjusted from reported pumped flow based on August 25, 1983 gaging program results.
3. Calf Pasture discharge data incomplete for 1975.

As indicated in Table E-8, dry weather pumping occurred in only six of the 14 years investigated. As previously indicated, this pumping occurred in response to the throttling at Columbus Park based on pumping limitations at Deer Island.

When Calf Pasture is called upon to operate under dry weather conditions, it serves the function of transporting raw sewage for discharge off of Moon Island as opposed to having it discharge through CSO's to the Fort Point Channel, Old Harbor and Dorchester Bay. This is considered a worthwhile function which should be continued until reliable pumping capacity is provided at Deer Island. To adequately perform this function, the station should be capable of pumping at a rate equal to the peak dry weather flow in its tributary area less a reasonable allowance for the flow that the Columbus Park Headworks can be expected to accept.

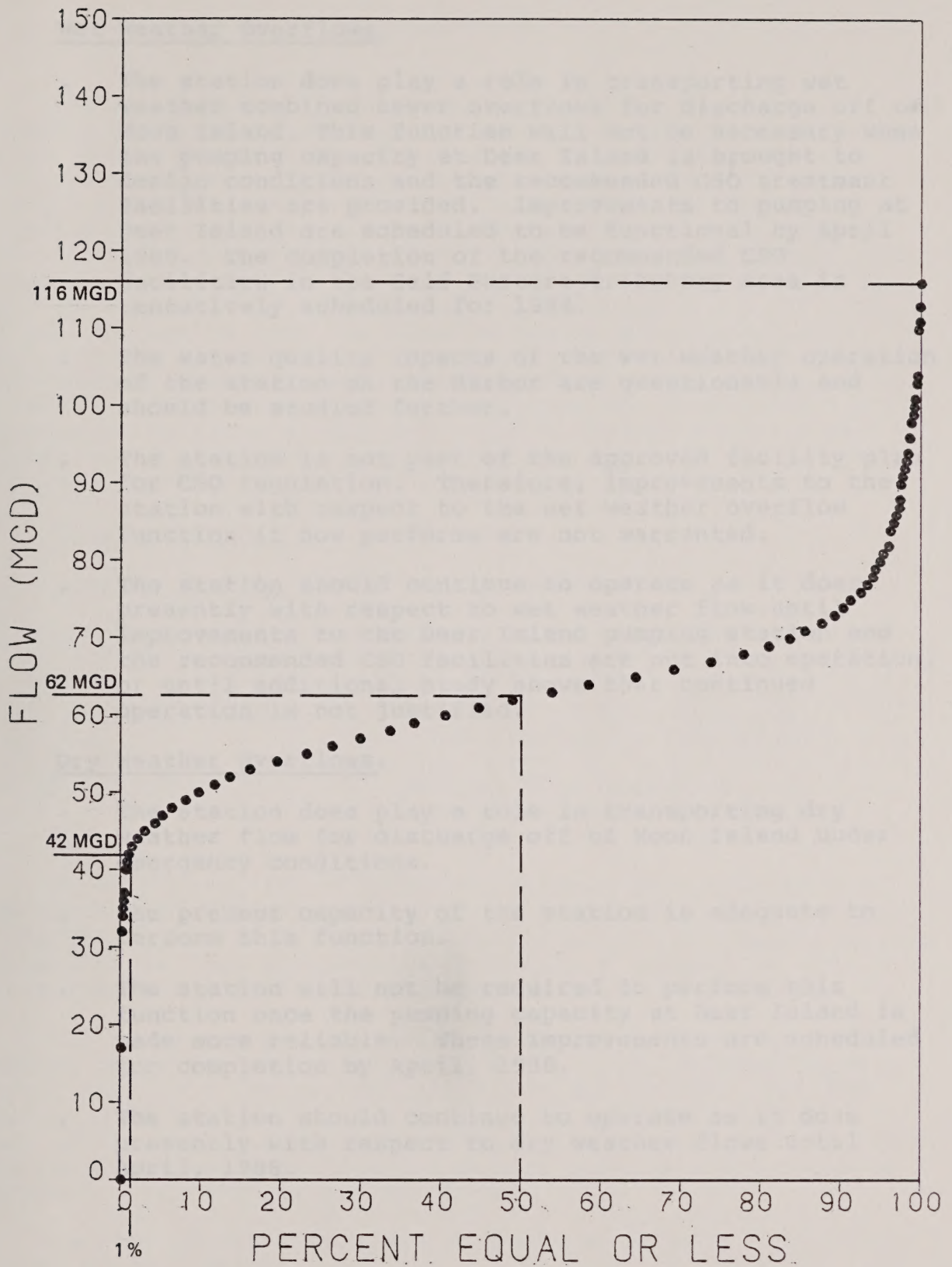
Figure E-25 presents a statistical analysis of daily flows through the Columbus Park headworks from January 1, 1979 through December 31, 1982. As indicated on Figure E-25, the highest flow for any day in the period was 116 mgd (million gallons a day) and the median for the period was 62 mgd. As indicated there were days during the period when no flow was accepted by the headworks. Calf Pasture is currently capable of pumping at a rate of 56 mgd as previously established. The estimated peak dry weather flow from the tributary system is 98 mgd. The statistical analysis presented on Figure E-25 indicates that during the period 1979 through 1982 Columbus Park accepted 42 mgd, the difference between the peak dry weather flow and the pumping capability of Calf Pasture, 99 percent of the time. It is therefore concluded that the present pumping capacity at Calf Pasture is adequate to perform the dry weather transport function it is currently called upon to provide. The station should continue to perform this function until April, 1988 when the pumping improvements to Deer Island are to be operational.

Summary of Conclusions

Following is a summary of the conclusions with respect to the function and continued need of the Calf Pasture Pumping Station:

Street Flooding and Back-ups.

- . The station does not play a significant role in the prevention of street flooding or back-ups into building connections.



**FIGURE E-25 FREQUENCY DISTRIBUTION FOR
COLUMBUS PARK FLOWS, 1979 - 1982**

E-32a

Wet Weather Overflows.

- . The station does play a role in transporting wet weather combined sewer overflows for discharge off of Moon Island. This function will not be necessary when the pumping capacity at Deer Island is brought to design conditions and the recommended CSO treatment facilities are provided. Improvements to pumping at Deer Island are scheduled to be functional by April 1988. The completion of the recommended CSO facilities in the Calf Pasture tributary area is tentatively scheduled for 1994.
- . The water quality impacts of the wet weather operation of the station on the Harbor are questionable and should be studied further.
- . The station is not part of the approved facility plan for CSO regulation. Therefore, improvements to the station with respect to the wet weather overflow function it now performs are not warranted.
- . The station should continue to operate as it does presently with respect to wet weather flow until improvements to the Deer Island pumping station and the recommended CSO facilities are put into operation, or until additional study shows that continued operation is not justified.

Dry Weather Overflows.

- . The station does play a role in transporting dry weather flow for discharge off of Moon Island under emergency conditions.
- . The present capacity of the station is adequate to perform this function.
- . The station will not be required to perform this function once the pumping capacity at Deer Island is made more reliable. These improvements are scheduled for completion by April, 1988.
- . The station should continue to operate as it does presently with respect to dry weather flows until April, 1988.

ALTERNATIVES

The Calf Pasture Pumping Station will be required to continue to operate to provide dry weather backup to Deer Island through 1988. In addition, the station will be required to continue to operate to provide the wet weather function it currently performs until either the CSO facilities are operational or additional study indicates that the wet weather function is not significant. Its current condition is poor and its hydraulic capacity is limited. This section identifies and evaluates alternatives with respect to maintaining the station from the present to the time when it can be abandoned. Five alternatives are considered. Alternatives No. 2 through 5 are progressive in that Alternative No. 3 includes the improvements included in Alternative No. 2, Alternative No. 4 includes the improvements in Alternatives No. 2 and 3, and Alternative No. 5 includes the improvements in Alternatives No. 2, 3 and 4. The alternatives are as follows:

<u>Alternative No. 1:</u>	No Action
<u>Alternative No. 2:</u>	Safety Improvements
<u>Alternative No. 3:</u>	Safety, Flow Measuring and Piping Improvements
<u>Alternative No. 4:</u>	Safety, Flow Measuring and Serviceability Improvements
<u>Alternative No. 5</u>	Safety, Flow Measuring, Serviceability and Pumping Improvements

In each case, the alternative is described, its present value (December 1983 ENR-4100) cost is presented, and advantages and disadvantages are listed. An environmental assessment of the alternatives is then presented and finally a summary of the alternatives rated against evaluation criteria is provided.

All costs are present value estimates. The present value of annual operation and maintenance costs is calculated using a discount rate of 7-7/8 percent as prescribed by EPA. For the calculation of present values, it has been assumed that the impact of the stations operation during wet weather will be found to be insignificant after further study, and the station can be abandoned in approximately five years.

Each alternative involves an abandonment cost. This cost includes the following:

Screen House

- dewatering
- bulkheading the Boston Main Interceptor at the screen house
- removing all equipment
- placing concrete at grade over the screen house opening
- sealing all building openings.

Pumping Station

- dewatering
- salvaging materials and equipment
- disconnecting utilities
- securing the building interior
- sealing all building openings.

Pipe Chamber

- dewatering
- removing fence
- bulkheading the deposit sewers
- placing concrete at grade.

The cost of abandonment is estimated as follows:

Screen House	\$ 37,000
Pumping Station	73,000
Pipe Chamber	<u>34,000</u>
Subtotal	\$144,000
Engineering & Contingencies	<u>36,000</u>
Total	\$180,000

A 25 percent allowance for engineering and contingencies has been used. The present value of the abandonment cost is \$129,000.

Evaluation of Alternatives

Alternative No. 1: No Action. Under this alternative the pumping station would continue to operate as it does currently. No capital improvements or modifications to the facility would be undertaken.

The estimated present value of costs for this alternative are:

Capital Cost	\$ 0
Abandonment	129,000
Operation & Maintenance (\$406,000 per year for five years at 7-7/8%)	<u>1,626,000</u>
Total	\$1,755,000

The operation and maintenance cost is a projection of the current cost of operating the station. It includes an allowance for routine equipment replacement, to the extent that such expenditures were made in the past from the operation and maintenance budget. These costs are quite substantial, and should be examined to determine if they can be reduced by staffing or operational modifications.

The advantage of this alternative is:

- It is the least cost alternative. No capital improvements are proposed and therefore no capital costs will be incurred.

Disadvantages associated with this alternative are as follows:

- There will be continued risks to operating personnel from the numerous safety hazards in the station.
- There will be continued risks to the equipment in the station due to the lack of influent screens.
- There will be continued risks of losing pumping capacity due to the condition of the existing pumps and associated piping.

Alternative No. 2: Safety Improvements. Under this alternative the safety deficiencies in the station would be

addressed. This alternative proposes that practical safety improvements to the station be undertaken. Specifically, these improvements would include the following:

Screen House

- improve lighting (explosion proof)
- emergency lighting
- repaired floor decking(1)
- new influent sluice gate and operator (explosion proof) with manual override
- new combustible gas detector and alarm
- new mechanical ventilation (explosion proof) activated by the lighting switch and the gas detector
- removal of debris and equipment not in use.

Pumping Station

- improved lighting
- emergency lighting
- repaired floor and decking(1)
- repaired and replaced railings
- new combustible gas detectors
- new mechanical ventilation activated by the gas detectors
- new pump motor shaft guards
- new cage around open bus bar system
- new screens in openings in pump motors
- removal of debris and equipment not in use.

-
1. As recommended under Group I in Weidlinger Associates, Calf Pasture Pumping Station - Preliminary Report. Boston Water and Sewer Commission, December 1983.

Pipe Chamber

- new lighting
- new fence
- new railing
- new safety grating.

The estimated present value costs for this alternative are:

Capital Costs

Screen House	\$ 87,000
Pumping Station	209,000
Pipe Chamber	<u>43,000</u>
Subtotal	\$ 339,000
Engineering & Contingencies	<u>136,000</u>
Total	\$ 475,000
Abandonment	129,000
Operation and Maintenance	
(\$433,000 per year for five years at 7-7/8%)	<u>1,735,000</u>
Total	\$2,339,000

An allowance of 40 percent for engineering and contingencies has been used for this alternative. This is due to the number of unknowns involved in modifying an existing structure of this type. The operation and maintenance cost for this alternative is greater than the previous alternative. This reflects the additional operating costs associated with equipment recommended under this alternative.

The advantage of this alternative is:

- It provides a safer environment and as a result minimizes the safety risks to which the operating personnel are exposed.

Disadvantages associated with this alternative are:

- It does not address the protection of station equipment with influent screens.
- It does not address the concerns with reliable pumping capacity.

Alternative No. 3: Safety, Flow Measuring and Piping Improvements. This alternative consists of all the safety improvements proposed in Alternative No. 2 and certain additional improvements. The additional improvements are intended to provide flow measuring capability at the station and enhance its reliable pumping capacity. Pump replacements are not included. However, the suction piping on two pumps would be replaced in an attempt to increase the pump capacity to the levels projected by the manufacturer's tests without replacing the pumps themselves. The additional modifications include:

Pumping Station

- new wet well level indicator
- new suction piping on pumps number 2 and 4.

Pipe Chamber

- new flow measuring device with pumping station readout.

Present value estimates of the costs associated with the improvements proposed in this alternative are as follows:

	<u>Alternative No. 2 Modifications</u>	<u>Additional Alternative No. 3 Modifications</u>	<u>Total Alternative No. 3</u>
Capital			
Screen House	\$ 87,000	-	\$ 87,000
Pumping Station	209,000	\$114,000	323,000
Pipe Chamber	<u>43,000</u>	<u>11,000</u>	<u>54,000</u>
Subtotal	\$339,000	\$125,000	\$ 464,000
Engineering & Contingencies	<u>136,000</u>	<u>56,000</u>	<u>192,000</u>
Total	\$475,000	\$181,000	\$ 656,000

Abandonment	\$ 129,000
Operation & Maintenance (\$433,000 per year for five years at 7-7/8%)	<u>1,735,000</u>
TOTAL	\$2,520,000

An allowance of 45 percent for engineering and contingencies has been used for the additional modifications proposed by this alternative. This percentage is higher than that for the previous alternative due to the potential for extraordinary complications associated with the improvements recommended under this alternative. The suction piping replacement is of particular concern in this regard. The additional cost of operation and maintenance attributable to the equipment recommended under this alternative would not be significant.

Advantages associated with this alternative include:

- It provides a safer environment and as a result it minimizes the safety risks to which the operating personnel are exposed.
- It provides a relatively accurate means for estimating station discharges.
- It attempts to provide additional pumping capacity without the costly replacement of pumps.

The disadvantages of this alternative are:

- It does not address the protection of the station equipment.
- It does not fully address the concerns with reliable pumping capacity.
- There is some uncertainty concerning the impact that the replacement of the suction piping will have on pumping capacity.

Alternative No. 4: Safety, Flow Measuring and Serviceability Improvements. This alternative consists of all the safety and operating improvements proposed in Alternatives No. 2 and 3 and several additional improvements. The additional improvements are intended to facilitate the operation of the station and to protect and further enhance its current level of reliability. In this alternative, a new mechanical screen is proposed for the screen house to protect the station from debris.

Also, the suction piping on the remaining three operable pumps would be replaced. This should improve the reliability pumping capacity of the station since each pump would have increased capacity. Consequently, each pump would be run less frequently than would be the case without the piping improvements, and the useful life of the pumps could be greater than previously estimated. The improvements under this alternative are:

Screen House

- new mechanically cleaned (manually activated) vertical bar screen.

Pumping Station

- new pump discharge gate valves with mechanical operators
- replace suction piping on pumps number 3, 5 and 6
- new electrical heating and ventilating for occupied areas.

The estimated present value costs associated with this alternative are as follows:

	<u>Alternatives No. 2 & 3 Improvements</u>	<u>Additional Alternative No. 4 Improvements</u>	<u>Total Alternative No. 4</u>
Capital			
Screen House	\$ 87,000	\$113,000	\$ 200,000
Pumping Station	323,000	326,000	648,000
Pipe Chamber	<u>54,000</u>	<u>-</u>	<u>54,000</u>
Subtotal	\$464,000	\$439,000	\$ 902,000
Engineering & Contingencies	<u>192,000</u>	<u>197,000</u>	<u>390,000</u>
Total	\$656,000	\$636,000	\$1,292,000
Abandonment			129,000
Operation & Maintenance (\$435,000 per year for five years at 7-7/8%)			<u>1,743,000</u>
Total			\$3,164,000

An allowance of 45 percent for engineering and contingencies has been used for the improvements added in this alternative. This is due to the potential for extraordinary complications associated with improvements recommended under this alternative. The operation and maintenance cost reflects the additional operating costs associated with equipment recommended under this alternative.

Advantages associated with this alternative include:

- It provides a safer environment and as a result it minimizes the safety risks to which the operating personnel are exposed.
- It provides protection to the station in the form of influent screening.
- It provides a relatively accurate means for estimating station discharge.
- It provides reasonable conveniences for operating personnel and other operating improvements.
- It attempts to provide more reliable pumping capacity without costly pump replacement.

The disadvantages associated with this alternative include:

- It does not fully address the concerns with reliable pumping capacity.
- There is some uncertainty concerning the impact that the replacement of the suction piping will have on pumping capacity.
- It requires a significant investment in capital equipment which has a useful life beyond that of the station.

Alternative No. 5: Safety, Flow Measuring, Serviceability and Pumping Improvements. This alternative consists of all the safety and operating improvements proposed in Alternatives No. 2, 3 and 4, and two new pumps. Specifically, this alternative includes the replacement of pumps number 2 and 4 with new identically rated pumps. The suction piping would be replaced as in Alternative No. 4. Pump drives and discharge piping would not be replaced.

The present value estimate of the costs associated with this alternative is as follows:

	<u>Alternatives No. 2, 3 & 4 Improvements</u>	<u>Additional Alternative No. 5 Improvements</u>	<u>Total Alternative No. 5</u>
Capital			
Screen House	\$ 200,000	-	\$ 200,000
Pumping Station	648,000	\$271,000	919,000
Pipe Chamber	<u>54,000</u>	<u>-</u>	<u>54,000</u>
Subtotal	\$ 902,000	\$271,000	\$1,173,000
Engineering & Contingencies	<u>390,000</u>	<u>135,000</u>	<u>525,000</u>
Total	\$ 1,292,000	\$406,000	\$1,698,000
Abandonment			129,000
Operation & Maintenance (\$435,000 per year for five years at 7-7/8%)			<u>1,743,000</u>
Total			\$3,570,000

An allowance of 50 percent for engineering and contingencies has been used for the improvements added in this alternative. This is higher than the previous alternative due to the potential for special complications associated with putting the new pumps into place and making them operational.

The advantages associated with this alternative are:

- It provides a safer environment and as a result minimizes the safety risks to which the operating personnel are exposed.
- It provides protection to the station in the form of influent screening.
- It provides a relatively accurate means for estimating station discharge.

- It provides reasonable conveniences for operating personnel and other operating improvements.
- It provides reliable pumping capacity up to a rate of 91 million gallons a day.

The disadvantages of this alternative are:

- It is the most costly alternative.
- It requires a significant investment in capital equipment which has a useful life far beyond that of the station.

Environmental Impacts

Construction Impacts. Alternative No. 1, no action, would not entail any construction impacts. The construction activities associated with Alternatives No. 2, 3, 4 and 5, the action alternatives, would generate minor to moderate, very short-term, noise and dust level increases at various locations on the Calf Pasture Pumping Station site. Since the site is relatively isolated, impacts upon the surrounding area would be negligible. Overall, anticipated construction impacts, or the lack thereof, do not constitute a significant difference among the alternatives.

Long-Term Impacts. A review of certain previously discussed considerations is warranted prior to addressing the long-term impacts of the Calf Pasture Pumping Station alternatives. The Calf Pasture Pumping Station is operated intermittently to relieve system overflows. These overflows occur when excessive wet weather flows or equipment breakdowns force the MDC to restrict the volume of wastewater entering its Deer Island Wastewater Treatment Plant. The pumping station accomplishes system relief by diverting a portion of the system's wastewater flow to an outer harbor discharge off Moon Island. Diversion of flow in this manner serves to reduce the volume of wastewater which would otherwise overflow to the Fort Point Channel, Old Harbor and Dorchester Bay. During wet weather, the diverted flow consists of a combination of wastewater and stormwater. During dry weather, the diverted flow consists of raw wastewater. An environmental assessment of the station's wet weather-related impacts requires a level of study which is beyond the scope of this Facilities Plan. The impacts associated with the dry weather operation of the station are somewhat more clearcut. While any discharge of untreated wastewater has adverse environmental implications, diversion to the outer harbor does serve to increase opportunities for dilution and time-related pathogen die-off. Thus, activation of the Calf Pasture station serves to mitigate adverse water quality, public health and recreational impacts by reducing the amount of untreated wastewater discharged to near shore waters.

Dry weather pumping will not be required after planned improvements at Deer Island are complete in April 1988. The completion of area CSO treatment facilities, currently scheduled for 1994, would preclude any need for wet weather pumping at Calf Pasture. However, it has been assumed that further study will show that the environmental benefit associated with the continued wet weather operation of the station at its current capacity is not significant. Thus, additional investment in the station for combined sewer regulation purposes is not justified. This is consistent with the findings of related combined sewer overflow studies which did not recommend a CSO role for the station. Given the preceding, this study anticipates the station will be abandoned in five years.

Alternative No. 1 (no action) would continue the safety risks under which the staff assigned to the pumping station currently operates. Continuation of the present risk level until the station is abandoned five years hence, entails a significant potential for adverse impacts upon the health and well-being of the facility's personnel. Alternatives No. 2, 3, 4 and 5 include the implementation of equivalent, practical safety improvements at the Calf Pasture facility. The contemplated improvements would upgrade the station's lighting, flooring, railing, ventilation and equipment enclosure systems, and would have a much-needed beneficial impact upon the facility's operating environment.

In addition to safety considerations, the alternatives address station reliability in various ways. Alternative No. 1 (No Action) and Alternative No. 2 (Safety Improvements) entail no increase in the reliability of the station's current capacity of 56 mgd. Alternative No. 3 (Safety, Flow Measuring and Piping Improvements) could result in a significant increase in the performance of two of the station's five operating pumps. However, the Alternative No. 3 improvements would probably translate into only a minor reliability increase since breakdowns due to debris or mechanical problems would remain distinct possibilities. Alternative No. 4 (Safety, Flow Measuring and Serviceability Improvements) would likely result in a moderate increase in station reliability. Alternative No. 4 would protect each pump from debris and could improve the output of each unit such that station capacity would be less affected by individual mechanical breakdown. Alternative No. 5 (Safety, Flow Measuring, Serviceability and Pumping Improvements) would constitute a major reliability improvement by increasing the station's capacity to a dependable 91 mgd and a potential capacity of 155 mgd if the suction piping improvements are successful.

As previously noted, the environmental significance of wet weather pumping at the Calf Pasture cannot be determined without

additional, detailed study. As a result, the wet weather water quality impacts associated with alternative levels of station reliability cannot be evaluated at this time. None of the alternatives preclude alteration of the station's operation once definitive information becomes available; however, Alternatives No. 3, 4 and 5 entail expenditures for capital improvements which future study may find to have been unnecessary.

The dry weather water quality implications of the alternatives must be viewed in terms of risk, rather than definitive impact. Alternatives No. 1 and No. 2 would continue the current level of risk that the Calf Pasture facility may be unable to fully divert raw sewage should future equipment breakdowns at the Deer Island Treatment Plant occur. The magnitude of the current risk is a matter for conjecture. However, four factors would appear to limit its significance. First, dry weather activation of the station generally has been an infrequent occurrence. During the eleven-year period, 1970 to 1980, the station was activated on only 16 dry weather days. Second, though the station was activated on 61 dry days during 1981, 1982, and 1983, the MDC has since overcome the critical breakdowns which prompted those activations. Third, an analysis of dry weather flow data for a fourteen-year period, including 1981, 1982, and 1983 indicates the station's current, 56 mgd, capacity would have been sufficient to divert all raw wastewater not accepted by the MDC ninety-nine percent of the time. Fourth, the chance of critical breakdowns at the Deer Island Wastewater Treatment Plant is expected to end by April, 1988. Alternatives No. 3 and No. 4 would serve to further limit the current level of risk in minor and moderate ways, respectively. Alternative No. 5 would provide the most protection from the risk of near shore, dry weather overflows; however, the additional reliability provided by this alternative may never be utilized.

As previously stated, each alternative includes provisions for abandoning the station. Abandonment will involve future construction operations encompassing the removal of equipment and the sealing of building openings and structures at grade. Impacts upon the area surrounding the site are expected to be minimal during these operations. The abandonment scheme is intended to render the site safe after it is no longer manned. The scheme does not involve any alteration which would irreversibly impact the historic or architectural significance of the main pumping station structure or preclude its productive reuse at a future time.

Comparison of Alternatives

Table E-9 presents a listing of the alternatives considered and the total present value cost for each. Table E-9 also indicates whether or not each alternative addresses the key concerns with respect to the pumping station, i.e. safety, serviceability and reliability.

Table E-9. COMPARISON OF ALTERNATIVES

Alternative	Present Value Cost (1)	Evaluation Criteria		
		Safety	Serviceability	Reliability
No. 1 No Action	\$1,755,000	not addressed	not addressed	not addressed
No. 2 Safety Improvements	2,339,000	addressed	not addressed	not addressed
No. 3 Safety Flow Measuring and Piping Improvements	2,520,000	addressed	addressed	not fully addressed
No. 4 Safety, Flow Measuring and Serviceability Improvements	3,164,000	addressed	addressed	addressed
No. 5 Safety, Flow Measuring, Serviceability, and Pumping Improvements	3,570,000	addressed	addressed	addressed

1. Annual costs converted to present values using a discount rate of 7-7/8%.

As indicated in Table E-9, Alternative No. 1, the no action alternative, is the least cost alternative, with each successive alternative being increasingly more expensive. Alternative No. 1 involves no capital expenditures. Alternative No. 2, the least cost action alternative, involves \$475,000 worth of capital expenditures which is approximately \$1.2 million dollars less than Alternative No. 5, the most costly alternative. The abandonment cost estimated to occur in 1988 is the same for each alternative and there is little variation in operation and maintenance costs among the alternatives.

All of the alternatives except Alternative No. 1 address the safety concerns at the station. Serviceability which refers to the ability to operate and maintain the station is addressed in Alternatives No. 3, 4 and 5. The principal serviceability improvement proposed by Alternative No. 3 is flow measuring capability. Alternatives No. 4 and 5 would add flow measuring

capability and influent screening which would contribute to serviceability. Reliability is addressed in Alternatives No. 3, 4, and 5. Alternative No. 3 would add new suction piping to two pumps which should improve the suction conditions and therefore the capacity and service life of each pump. The new suction piping has the potential of increasing the capacity of the station from the existing 56 mgd to 80 mgd. Alternative No. 4 would add new suction piping to the remaining three pumps, which would increase station capacity to 143 mgd if the overheating problem in pump number 5 can be solved. Also the influent screen that would be added in Alternative No. 4 would increase the reliability of the station by protecting the pumps from potential damage from debris. The new pumps, suction piping and influent screen that would be added in Alternative No. 5 would assure reliable station operation to a minimum of 91 mgd and would offer the potential of pumping 155 mgd from the station.

The short-term, construction-related, environmental impacts anticipated under each alternative are not significant. Over the long term, each of the action alternatives would have a beneficial impact on the health and safety of operating personnel. To the extent that Alternatives No. 3, 4 and 5 improve the reliable pumping capacity of the station, each would contribute in increasing degrees to the ability of the station to perform the wet and dry weather functions it currently provides. The significance of the station's wet weather function is uncertain. Pumping dry weather flows at Calf Pasture would appear to offer significant environmental benefits from a water quality perspective.

RECOMMENDATIONS

Based on the preceding analysis, the following is recommended with respect to the improvement and operation of the Calf Pasture Pumping Station:

- . Make safety improvements as described in Alternative No. 2 immediately, at an estimated cost of \$475,000 (ENR 4100)
- . Undertake further study to evaluate the environmental significance of the wet weather operation of the station.
- . Continue to operate the station to pump dry weather flow until reliable pumping capacity is provided at the MDC Deer Island Wastewater Treatment Plant.
- . Continue to operate the station to pump wet weather flow until further study shows that wet weather pumping is not environmentally significant or until combined sewer overflow regulating facilities become operational in the area affected by the station.
- . Abandon the station when its dry and wet weather operations are discontinued, at an estimated cost of \$129,000 (ENR 4100)
- . Pursue transfer of ownership and operating responsibility of the station to the MDC.

The recommendation to make the safety improvements is based on the need to improve the working conditions at the station given that it will have to continue to operate for an additional period of time. The flow measuring and piping improvements associated with Alternative No. 3 would add an estimated \$181,000 to the cost of the Alternative No. 2 safety improvements. Providing accurate, flow measuring capability at the station at a reasonable cost is difficult. The flow measuring capability included in Alternative No. 3 is relatively inexpensive, \$125,000, but questionable in terms of accuracy. While it would be an improvement over the current practice of estimating station discharge, the cost of the flow measuring improvements is not justified by the additional accuracy. This is particularly true since the measured value, station discharge, is not used for any critical purpose. The new suction piping proposed under Alternative No. 3 could increase station capacity, but there is no apparent need to do so at this time.

Alternative No. 4 proposed new pump suction piping and a new influent screen, in addition to the improvements suggested in Alternative No. 3. These improvements would cost an estimated

\$817,000 over the cost of the safety improvements. As with Alternative No. 3, the increase in capacity that could result from the new suction piping is not apparently needed at this time. The new influent screen is costly, \$113,000, and represents an expense that cannot be justified assuming that it may be possible to abandon the station in 1988.

The proposed Alternative No. 5 improvements would cost an estimated \$1,223,000 over the safety improvements. The new pumps proposed in this alternative would assure reliable station capacity, but as with the influent screen the pumps would be expensive, \$406,000, and they would serve no purpose if the station were abandoned in 1988. In addition, the delivery and installation time of the pumps is likely to take up to two years which would significantly reduce their period of contribution.

The recommendation for further study of the environmental significance of the wet weather operation of the station is important. It has been assumed in developing improvement alternatives and making recommendations that the wet weather function performed by the station is not environmentally significant. Confirmation of this assumption would allow abandonment of the station in 1988, when pumping improvements at Deer Island are effected. It would also allow discontinuation of wet weather pumping which would substantially reduce operating costs. If the wet weather operation of the station is found to be important, consideration should be given to advancing the scheduled implementation dates of combined sewer overflow regulation facilities in the area to allow the abandonment of Calf Pasture as close to 1988 as possible. Operation of the pumping station beyond this point could require new pumping units since the current units have an optimistic remaining service life of five years. An investment in new pumping units, given the prospect of abandoning the station in five to ten years, would not be well advised.

The recommendation that the BWSC should pursue the transfer of ownership and operating responsibility of the Calf Pasture Pumping Station to the MDC is based on the fact that the role of the station is to provide relief to MDC facilities. The station performs no other function. Accordingly it should be owned and operated by the MDC.

ATTACHMENT E-1
PROJECTED PUMP PERFORMANCE CURVES

DATE 9-20-83
PROJECT 50 MGD CENTRAL PUMP
CLIENT CALP ENGRS INC
LOCATION BOSTON MASS

1947. The first of these was the 1947-48 season when the total catch was 1,100 tons. This was a record for the post-war period and was due to a combination of factors, including a high level of effort and a high level of effort.

The second of the three periods was the 1950-51 season when the total catch was 1,000 tons. This was also a high level of catch and was due to a combination of factors, including a high level of effort and a high level of effort.

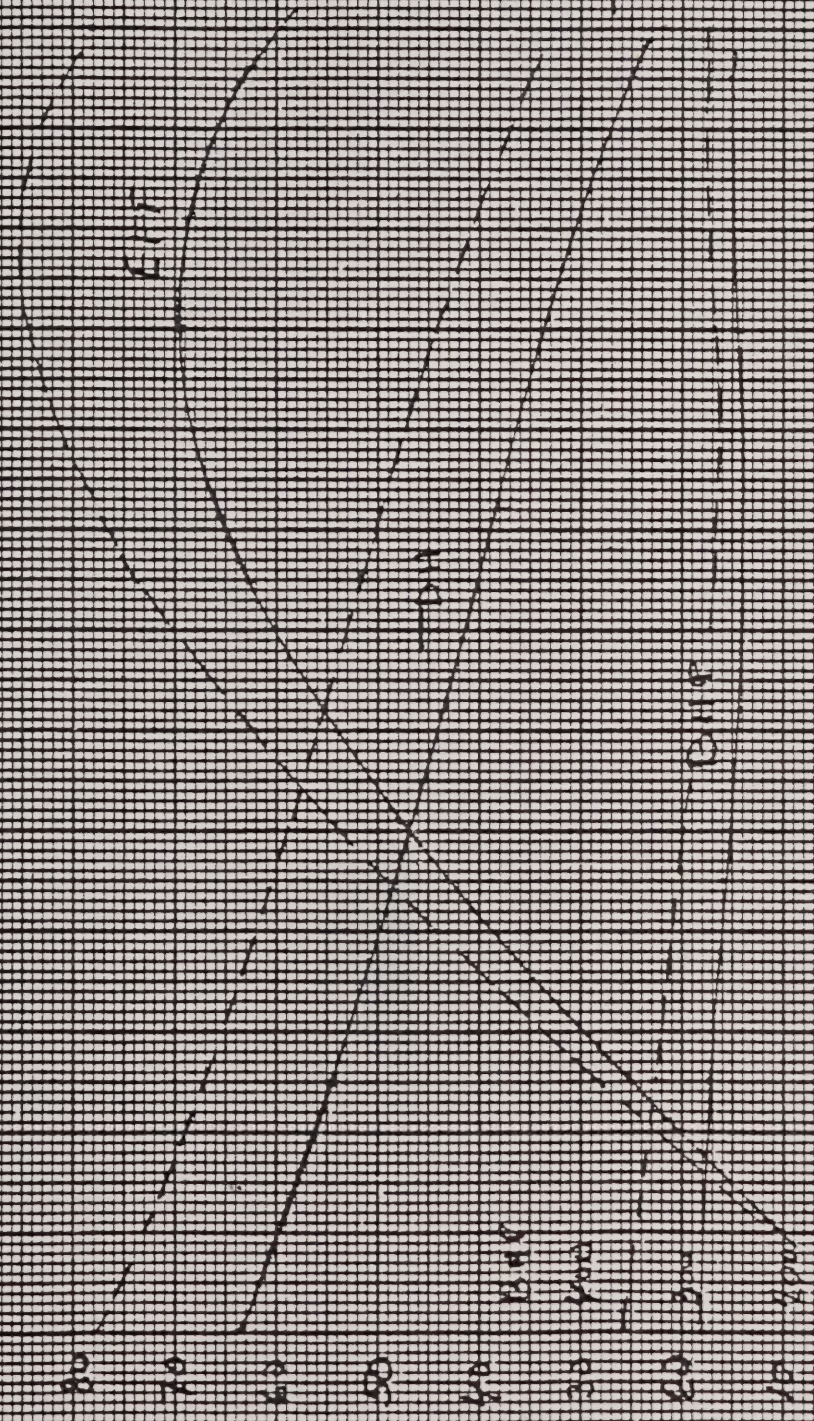
The third of the three periods was the 1952-53 season when the total catch was 1,000 tons. This was also a high level of catch and was due to a combination of factors, including a high level of effort and a high level of effort.

The fourth of the four periods was the 1954-55 season when the total catch was 1,000 tons. This was also a high level of catch and was due to a combination of factors, including a high level of effort and a high level of effort.

ORIGINAL COS 2.2750 GPM
TH = 88.5

TDH FT
GPM %

~ 580 RPM



PROJECTED PERFORMANCE
ANGLES FROM
TEST DATA
TAKEN 8-24-83
RATED PERFORMANCE

3 100000 GPM

Q. No.	DATE	9-20-83
ORDER NO.	E W/for -3	
DRAWN BY	Worthington Group, McGraw-Edison Company	
SERVICE	SEWAGE	SIZE AND TYPE
CALF PASTURE ST.	30 MS	CONTR. PUMP
BOSTON MASS	3	

3-25-82
E-W-M-E

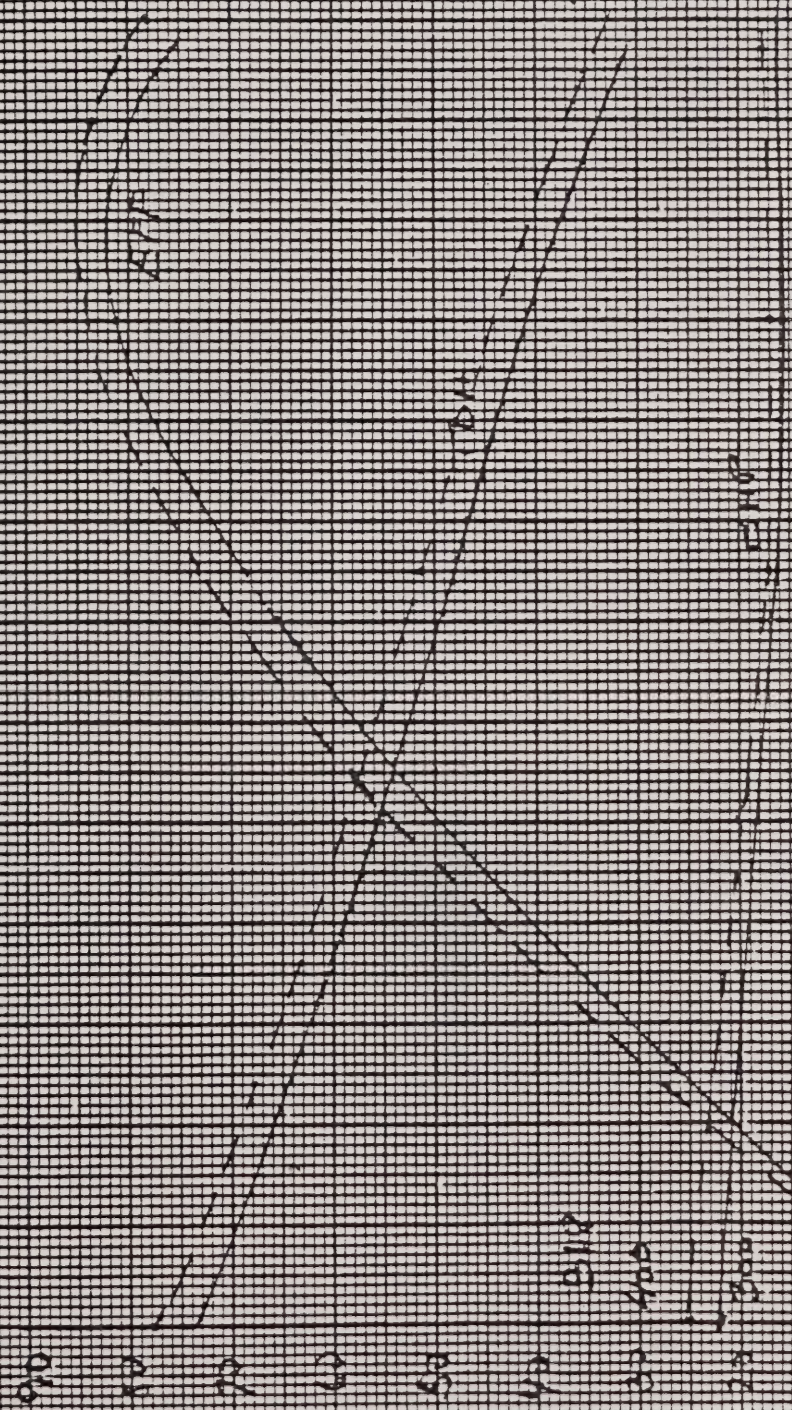
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10/11/82
10/11/82

ORIGINAL COS 22750 RPM
TH = 38.5

TDK FT
C/F %



~ 580 RPM

3 1 10000 RPM

O. No.	SERVICE	Worthington Group, McGraw-Edison Company	DATE	9-20-83
ORDER NO.	SEWAGE			
DRAWN BY	CALF PASTURE ST.	SIZE AND TYPE	30 MS CENTR. PUMP	E mfu-4
	BOSTON MASS.			

DATE: 10/10/62

BY: [Signature]

TO: [Signature]

FROM: [Signature]

[Faint, illegible text covering the main body of the page, possibly bleed-through from the reverse side.]

WARREN PUMP -

CURVE PROTECTED FROM
DATA TAKEN DURING TEST
PUMPING AND ARE
APPROXIMATE

7000
6000
5000

40

30

20

10

0

7000

6000

5000

4000

3000

2000

1000

0

70

60

50

40

30

20

10

0

TPH

BWS

20

30

PROTECTED PER-
FORMANCE FROM
TEST DATA
TAKEN 8-15-82

AS 1000 GPM

Q. No.

ORDER NO.

DRAWN BY

SERVICE SEWAGE

CALF PASTURE ST.

BOSTON MASS.

Worthington Group, McGraw-Edison Company

SIZE AND TYPE 36" VERTICAL CENTR. PUMP

N^o 5

DATE

9-13-83

E

W-1

ORIGINAL COS 28000 GPM

TH 42'

ALTERED COS 28000 GPM

TH 36"

350 RPM

PROTECTED PERFORMANCE

FROM TEST DATA TAKEN

8-15-83

RATED PERFORMANCE

40 - 1000 GPM

Q. No.

ORDER NO.

DRAWN BY

W. W. W.

SERVICE BEVERAGE

CALF PASTURE ST.

BOSTON MASS.

Worthington Group, McGraw-Edison Company

SIZE AND TYPE 36 VERTICAL CENTR. PUMP

N^o 6

DATE 9-13-83

E W. W. W. - 2

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